The Engineer

LONDON, FRIDAY, OCTOBER 23, 1942.

PUBLIC NOTICES

PORT OF BRISTOL AUTHORITY

POSITION OF CHIEF ASSISTANT ENGINEER

The Port of Bristol Authority invite APPLICATIONS for the POSITION OF CHIEF ASSISTANT ENGINEER.

Applicants should be about forty years of age and not over forty-five years of age.

Any applicant must be a member of the Institution of Civil Engineers and should have had experience as a Civil Engineer in connection with Dock and Harbour Works. Experience of the Maintenance of Dock Works is essential, as well as of the carrying out of large new works let by contract and of smaller works undertaken departmentally. A good administrator is required with knowledge of the routine work of a Dock Engineer's office.

The salary will be Grade 6 of the Bristol Corporation's scale, viz., between £800 and £1000 per annum.

During the period of the emergency the appointment would, in accordance with the resolution of the Bristol City Council, be temporary and subject to one month's notice on either side. At the end of the period of the emergency, if the holder of the post had performed his duties to the satisfaction of the Port Authority, he would receive special consideration upon the invitation of applicants for the permanent appointment as Chief Assistant Engineer. The permanent appointment would then be held during the pleasure of the Port Authority and would be subject to the provisions of the Local Government Superannuation Act, 1937, in connection with which the successful candidate would be required to pass a medical examination and the statutory contributions under the Act would be deducted from the salary.

Applications, in writing, stating age, training, previous employment, present position, experience, etc., should be forwarded to the undersigned not later than the 7th November, 1942, and should be accompanied by copies of three recent testimonials. The envelope should be endorsed "Chief Assistant Engineer."

Canvassing, either directly or indirectly, will disqualify an applicant.

R. H. JONES,
General Manager.

Docks Office,
Queen Square,
Bristol, 1. 8883

SOUTH HOLLAND LAND DRAINAGE TRUST

ENGINEERING ASSISTANT

Engineering Assistant (TEMPORARY) REQUIRED as RESIDENT for major works of improvement to be carried out in the above Board's main drain. Preference will be given to applicant with experience of Fen Drainage. Salary £600 per annum, plus war allowance. Applications, together with details of qualifications, experience, and copies of three recent testimonials, should be forwarded to the undersigned not later than 7th November, 1942.

E. G. TAVERNER.

Deeping House,
The Crescent,
Spalding. 8902

THE CORPORATION OF GLASGOW

EDUCATION DEPARTMENT

COLLEGE OF SCIENCE AND TECHNOLOGY, SCHOOL OF ENGINEERING

Two Instructors are REQUIRED for Day Classes for Training of Marine Engineers for Board of Trade Certificates of Competency.

Candidates should hold the Extra First Class Certificate of the Board of Trade or equivalent qualification and should be competent to conduct laboratory work in testing of heat engines and strength of materials. They should have not less than 7 years' sea experience, preferably on both steam and motor vessels. Teaching experience will be an advantage.

The salary attaching to the appointments is on the scale of £400 to £500 by annual increments of £20, subject meantime to a deduction of 10 per cent.

Forms of application may be obtained from the Director of Education, 129, Bath Street, Glasgow, C.2, to whom completed forms, accompanied by copies of not more than three testimonials, should be returned not later than 20th November, 1942.

WILLIAM KERR,
Town Clerk.

City Chambers,
Glasgow,
October, 1942. 8884

TO ADVERTISERS UNDER BOX NUMBERS IN SITUATIONS OPEN SECTION.

For the benefit of applicants, the Proprietors are prepared to insert brief notices that vacancies are filled, upon receipt of notifications from the advertisers. These notices (limited to one line) will be free of charge, and co-operation is asked for.

The Engineer

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NOTICE

CORRESPONDENCE *re* Accounts and Remittances should be sent in future to:

28, ESSEX STREET, STRAND, LONDON, W.C.2, and NOT to Bath.

This change has been caused by enemy action, and co-operation is earnestly asked for.

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, MAN with Technical Knowledge to REPRESENT well-known firm of London Stockholders for sale of Valves to Laundry and General Engineers and all Steam Users. State salary required.—Address, 8904, The Engineer Office. 8904 A

EDITOR REQUIRED by a Leading Scientific Institution to Take Charge of its Publications. Candidates should hold an Engineering or Physics Degree, have had Administrative as well as Editorial experience of a technical nature, and preferably be Corporate Members of the Institutions of Civil, Mechanical, or Electrical Engineers. Age from 35 to 45 years. Commencing salary in accordance with qualifications and experience.—Address, 8896, The Engineer Office. 8896 A

SITUATIONS OPEN

COMMERCIAL MANAGER REQUIRED for permanent post with firm on Gear Production Work of national importance; good general knowledge of Engineering, Estimating, and Fixing of Prices; also Modern Manufacturing Times. Salary up to £500 per annum. Full details in confidence.—Address, 8905, The Engineer Office. 8905 A

ENGINEER REQUIRED for Permanent Post on work of first national importance; age 30 to 42. First-class general and technical education essential, with good executive experience and knowledge of modern manufacturing methods. Salary £1000 per annum, rising to £1800 per annum.—Full details, including technical qualifications, positions held, and salaries earned, in confidence, to Box 11, Strand House, London, W.C.2. 8846 A

PUBLIC NOTICES

LOUGHBOROUGH COLLEGE

Principal: Dr. H. SCHOFIELD, M.B.E.

Applications are Invited for the POST of LECTURER in MECHANICAL or ELECTRICAL ENGINEERING. A degree (or equivalent) is essential. Salary according to the Burnham Technical Scale, plus war bonus.—Forms of application, which should be returned on or before 31st October, may be obtained on application to the REGISTRAR, Loughborough College, Loughborough, Leics. 8861

CITY OF LEICESTER EDUCATION COMMITTEE

COLLEGE OF TECHNOLOGY AND COMMERCE

Principal:
L. W. KERSHAW, B.Sc., A.M.Inst.C.E., F.G.S.

Required Immediately, a LECTURER in MECHANICAL ENGINEERING, with some knowledge of Electrical or Automobile Engineering.

Applicants should have had good Works Experience and should possess a Degree in Engineering or equivalent qualification.

The position is a full-time one, with salary according to the Burnham Technical Scale, plus war bonus, with additional increments for industrial experience and special qualifications.

Applications, stating age, places of education, training, qualifications, teaching and industrial experience, accompanied by the names of three referees, should be submitted to the Principal not later than the 7th November, 1942.

H. S. MAGNAY,
Director of Education.

Education Department,
Newarke Street,
Leicester,
19th October, 1942. 8903

MIDDLESBROUGH EDUCATION COMMITTEE

CONSTANTINE TECHNICAL COLLEGE

Principal:
H. V. FIELD, B.Sc., Wh.Sch., M.I.E.E.

Applications are Invited for FULL-TIME LECTURER in MECHANICAL ENGINEERING from University Graduates (or equivalent qualifications), preferably with industrial experience.

Salary will be payable in accordance with the Burnham Scale for Technical Teachers.

The appointment will commence on 1st January, 1943, or as soon as possible after that date.

Application forms (returnable by 9th November, 1942), may be obtained from the undersigned by forwarding a stamped addressed envelope.

STANLEY MOFFETT,
Director of Education.

Education Offices,
Middlesbrough,
October, 1942. 8899

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CLASSIFIED ADVERTISEMENTS CLOSE FOR
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The Engineer

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ADVERTISEMENTS

The Charges for Classified Advertisements are 1/6 per line up to one inch—minimum charge, 9/-; those occupying one inch or more at the rate of 18/- per inch. Box numbers, 1/- extra, except in the case of advertisements under "Situations Wanted." Orders MUST be accompanied by a remittance. The rates for Displayed Advertisements will be forwarded on application. Classified Advertisements cannot be inserted unless delivered before TWO o'clock on Wednesday afternoon.

Letters relating to the Advertisement and the Publishing Departments of the Paper are to be addressed to the Publisher; all other letters are to be addressed to the Editor of THE ENGINEER.

Postal Address,
26, Essex Street, Strand, London, W.C.2.
Teleg. Address,
"Engineer Newspaper, Estrand, London."
Tel., Central 6565 (10 lines).

SITUATIONS OPEN

IMPORTANT

Advertisers in Situations Open Column should make themselves acquainted with the terms of

STATUTORY RULES & ORDERS 1941 No. 2069

RESTRICTION ON ENGAGEMENT ORDER

INDIAN ORDNANCE SERVICES.
The Ministry of Labour and National Service, Central (Technical and Scientific) Register Branch, INVITE APPLICATIONS for APPOINTMENT as WORKS MANAGERS in the Indian Ordnance Services.

Appointments will be for the duration of the war, with a minimum period of one year, subject to three months' notice on either side. Salary, the equivalent of £1125 per annum, rising by £90 per annum to £1485 per annum.

On the recommendation of the Interviewing Board, a candidate may be granted an initial salary on any point within the above scale.

Free passage both ways is provided. Bonus on termination of service.

Application forms may be obtained from the MINISTRY OF LABOUR AND NATIONAL SERVICE, CENTRAL (TECHNICAL AND SCIENTIFIC) REGISTER, Sardinia Street, London, W.C.2. The reference number of the post applied for must be quoted.

The existing vacancies with the qualifications required for each post are detailed below. Consideration will be given to applications from candidates not possessing full qualifications if their experience renders them particularly suitable for appointment.

WORKS MANAGERS, CASE FACTORY.

General qualifications: Good general education to Degree standard, preferably accompanied by indentured apprenticeship with recognised firm of mechanical engineers.

SPECIAL QUALIFICATIONS.

1. ENGINEER, with experience of Maintenance of large Non-ferrous Melting and Rolling Mill Plants, Heavy Press Installations and Annealing Plants. Reference Number C.1222.

2. METALLURGIST to specialise in Technical Control of Non-ferrous Metal Production, including Melting, Alloying, and Working of various natures of Strip. Output will consist of Deep-drawn Non-ferrous Pressings manufactured on a quantity production basis, and officer will be responsible to General Manager for quality of products of factory. Reference Number F.759.

3. PRODUCTION MANAGER for Mass Production of Deep-drawn Non-ferrous Pressings through all operations from Melting and Alloying of Metal to Finished Product. Reference Number C.1223. 8900 A

MANAGER, ELECTRICAL CONTRACTING DEPT., essential firm, London; experience Design, Estimating, Control, and Supervision of Outside Contracts, Factory Installations and Maintenance.—Address, 8914, The Engineer Office. 8914 A

MANAGER, HEATING, VENTILATING, ELECTRICAL DEPT. essential firm, London; industrial installation; experienced knowledge of Design. Able to secure own contracts.—Address, 8908, The Engineer Office. 8908 A

MANAGER REQUIRED for ENGINEERING WORKS; must have 'full know. of Capstan and Milling Machines and able to Supervise 75 men. Send age, credentials, and salary req.—Address, P4459, The Engineer Office. P4459 A

MANAGER, BUYING DEPT., Essential Firm N.E., London; contractors and general engineering materials. Give details experience.—Address, 8895, The Engineer Office. 8895 A

PROGRESS MANAGER REQUIRED for large General Engineering Works in the North, engaged on a wide variety of work.—Address, stating age, experience and salary required, 8893, The Engineer Office. 8893 A

TECHNICAL SALES REP. REQUIRED for London area by well-known Firm of Repetition Engineers. Young man, exempted military service, preferred. Salary plus commission. Address, with full details education, training, and salary required, 8885, The Engineer Office. 8885 A

SITUATIONS OPEN

OVERSEAS EMPLOYMENT. — ASSISTANT DISTRICT RUNNING SUPERINTENDENTS are REQUIRED for the Government Railway in Nigeria, in the first instance for the duration of the war or one tour of 12 to 24 months, whichever is the lesser period, with possibility of permanency. In certain circumstances it might be possible to arrange for British Railway personnel to return to their present employment after the war. Salary, £475, rising to £920. Commencing salary within this scale according to qualifications and experience. Separation allowance for married men is £80 on salary of £475. Free passages and quarters. Candidates should be Associate or Graduate Members of the Institution of Mechanical Engineers or hold an equivalent qualification, have served a pupillage or apprenticeship with a British railway or firm of locomotive builders, and have some running shed and footplate training.—Written applications (no interviews), giving full details of age, training, experience, and name of present employers, should be sent to the SECRETARY, Overseas Manpower Committee (Ref. 475), Ministry of Labour and National Service, Hanway House, Red Lion Square, London, W.C.1. 8888 A

SHIPBUILDING ENGINEER REQUIRED for nationally important work. Highest technical qualifications and good executive experience in charge of Shipyard Production absolutely essential. Age 30-42. Salary £1000 per annum, rising to £1800 per annum.—Write full particulars, including age, education, qualifications and experience in chronological detail, with salaries earned, to Box 22, Strand House, London, W.C.2. 8881 A

THE Post You are Seeking May Not be Advertised in this Column, but do not lose the Opportunity of Bringing your Requirements before all those who would be interested and could employ you. An Advertisement in the "Situations Wanted" Column would be seen by all Leading Engineering Concerns for the cost of Four Lines, 6s.; 1s. 6d. for each Additional Line. There is no better way of covering so large a field for such a small charge.

SITUATIONS WANTED

CHIEF ENGINEER (43), Controlling Large concern, DESIRES CHANGE; exceptionally wide experience in mech., elec., civil, and chemical engineering, also research, development, and sales organisation. Open for re-engagement October 30th.—Address, 8916, The Engineer Office. 8916 B

COST ACCOUNTANT (F.C.W.A.) (41) DESIRES EXECUTIVE POSITION as Cost Controller, Assistant to Managing Director, or similar post where abilities can be fully utilised on essential work; 12 years' experience mass production, job, process costs, stores, control, mechanised accounting; used to controlling staff; available one month.—Address, P4461, The Engineer Office. P4461 B

DESIGNER DRAUGHTSMAN, 18 Years' Experience of internal combustion engines, petrol, and diesel, such as Sunbeam, Bristol, McLaren, Brooke, Perkins, Burmeister-Wain, &c., DESIRES EXECUTIVE POST, either Drawing-office or Experimental Test, and preferably High-speed Diesel. Commissioned Engineer Office R.A.F., with 2½ years' experience, home and Egypt; shortly resigning commission.—Address, P4453, The Engineer Office. P4453 B

ELDERLY ENGINEER, A.M.I. Mech. E., wide general experience, DESIRES MANAGEMENT Small Concern or Factory. Permanency; moderate salary.—Address, P4454, The Engineer Office. P4454 B

ENGINEER (38), Experienced Process Management, maintenance, and erection, OPEN to ACCEPT MANAGERIAL or SUPERVISORY CAPACITY. Representative.—Address, P4458, The Engineer Office. P4458 B

IF the Man You Are Seeking is Not Amongst those Advertising in this Column, a Small Announcement in the "Situations Open" Column will Quickly and Economically Produce the Right Selection of Applicants, at the same time Eliminating Waste of Effort, Waste of Time, and Waste of Opportunity. The charge is Four Lines or under, 6s.; each Additional Line, 1s. 6d. Box Numbers, 1s. extra, which includes despatch of all replies.

METALLURGIST, with Long Practical Experience of analysis and steel-making by open-hearth and Tropenas furnaces, now doing minor duties, DESIRES POSITION where qualifications may be used on more important work.—Address, P4451, The Engineer Office. P4451 B

PLANT and MAINTENANCE ENGINEER (48), manager supervisory heavy industries, D.O. ex., FREE END of OCTOBER; crushing plants, fertilisers.—Address, P4462, The Engineer Office. P4462 B

POSITION REQUIRED as Chief Designer or Production Engineer, London area; machine tools, special-purpose machines, jigs and tools, planning, methods investigation; min. salary, £600.—Address, P4455, The Engineer Office. P4455 B

QUALITY CONTROL (THEORY AND PRACTICE).—EX-OFFICER OFFERS SERVICES for essential war work only. Country preferred.—Address, P4452, The Engineer Office. P4452 B

SKILLED ENGINEER, Life Experience, DESIRES RESPONSIBLE SITUATION; experienced tool-room, machine shop work, and aircraft assembly, also planning, estimating, and rate-fixing; Chief Rate-fixer or like; age 30 years.—Address, P4456, The Engineer Office. P4456 B

SITUATIONS WANTED

TECHNICAL GENERAL MANAGER or WORKS MANAGER, engineer of proved ability REQUIRES POST in London area; fully qualified, good disciplinarian and organiser, accustomed to handling both male and female labour, thorough knowledge of design, planning progress, buying, and all works departments; 51 years of age, energetic and well connected with all Ministerial Depts.—Address, 8917, The Engineer Office. 8917 B

WORKS and PRODUCTION MANAGER DESIRES CHANGE; age 43, with 20 years' managerial experience, including modern machine shop, sheet metal, and presswork, light and heavy engineering, production planning, estimating, rate-fixing, progress, &c.; controlled 3000 male and female labour; Associate Member, Works Management Association.—Address, P4457, The Engineer Office. P4457 B

AGENCIES

LONDON Industrial Organisation, Acting as purchasing agents for war contracts, PREPARED UNDERTAKE ADDITIONAL BUYING and SELLING REPRESENTATION; commission basis.—Address, P4460, The Engineer Office. P4460 D

MR. D. SUTHERLAND, Large Industrial Sales representative for (20 years) W. and T. Avery, Ltd., now resident Devon and representing London engineering firm, calling on all classes industrial works, Devon, Somerset, and Dorset, WANTS ADDITIONAL GOOD REPRESENTATION on expenses and commission.—14, Tarraway Road, Paignton, Devon. P4463 D

SUB-CONTRACTING

WANTED

LIGHT PRESSINGS and STAMPINGS WORK WANTED in all metals; 20-Ton Presses.—C.S., Ltd., Staffa Works, Staffa Road, E.10. 8909 MW

MACHINING WORK REQUIRED, Large or small lots, suitable for Centre Lathes (9in. crs. by 8ft.), Slotters, Drills, Shapers, Planers, &c.—STRINGERS, Ltd., Wincobank, Sheffield. 8084 MW

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WE ARE PAINT SPECIALISTS ON STEEL WORK. If you have a problem—let us deal with it. Do you want replacements of material? Does your brick stack need pointing? How are your tanks off for a coat or two of paint before the winter? NOW'S the time to give all steel good protection. Who wants 45ft. of ¼in. plate, 12in. dia., FLANGED CHIMNEY? This is a bargain parcel.—ESERIN (STEEPLEJACKS), Ltd., 7, Great Castle Street, W. 1 (Langham 2914). 8863 MW

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Especially in view of Air Raid and Working Conditions, study at home with the T.I.G.B. in order to achieve the best progress and results. Write to-day for "The Engineer's Guide to Success"—FREE—containing the world's choice of Engineering Courses—over 200—covering all branches and recognised qualifications. Mention branch, post of qualifications that interests you. The T.I.G.B. guarantees training until successful.

THE TECHNOLOGICAL INSTITUTE OF GREAT BRITAIN
76, TEMPLE BAR HOUSE, LONDON, E.C.4.

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WANTED, 150 Tons ROLLED STEEL JOISTS, 6in. by 4in. to 12in. by 6in., fabrication.—Address, 8907, The Engineer Office. 8907

WANTED, MACHINERY for MAKING STAMPED LINK CHAINS. Particulars —Address, 8898, The Engineer Office. 8898

ALFRED HERBERT, Ltd., Coventry, PAY BEST PRICES FOR SECOND-HAND MACHINE TOOLS in good condition by first-class makers.

Write, wire, or 'phone, and our representative will call.

'Phone: 88781 (12 lines), Coventry; Telegrams: "Lathe, Coventry." 1002

ALL CLASSES of MACHINE TOOLS PURCHASED for CASH on advice to the following addresses:—

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NORMAN POTTS (SCOTLAND), Ltd., 61, Wellington Street, Glasgow, C.2.

G. and W. POTTS (SUNDERLAND), Ltd., Portobello Lane, Sunderland. 8877

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THE
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NEW AND SECOND-HAND TABLES, CHAIRS, CUTLERY, CROCKERY, INSULATED URNS, TEA-COFFEE SETS, FISH FRIERS, ALL ENAMELWARE, ETC.
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56, VICARAGE ROAD, WATFORD.
Phone: WATFORD 3782. 8906

FOUR SECOND-HAND T-SLOTTED CAST IRON or STEEL SLABS with machined face. For bolting to concrete floor to form jigging tables. Size approx. 10ft. by 8ft., 8ft. by 6ft. Old planer or other machine tables would be suitable. Smaller sizes to make up considered.—W. J. FRASER and CO., Ltd., Dagenham ('Phone, Seven Kings 2872). 8

We are licensed by the Machine Tool Control for the purchase of all classes of Machine Tools, and we offer good prices for surplus Machinery in any quantities, large or small.

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1½ IN. CAPSTAN LATHE; Small or Medium JIG BORING MACHINE; ONE 10in., 8in., and 6in. centre LATHES, 10ft., 6ft. bed; ONE medium VERTICAL MILLING MACHINE. All preferably electrically driven. THE LONDON ELECTRIC FIRM, Croydon. 8894

PATENTS

THE PROPRIETORS of BRITISH PATENTS Nos. 499,434, "Cutter Blades and Methods of Making Them," and 499,436, "Milling Cutters and Other Inserted Blade Cutters," DESIRE TO SELL the PATENT RIGHTS, to GRANT MANUFACTURING LICENCES, or to make other arrangements on reasonable terms for the purpose of working the inventions in this country.—For further particulars apply to MATHYS and SQUIRE, 52, Chancery Lane, London, W.C.2. 8886

THE PROPRIETOR of BRITISH PATENT No. 511,582, dated February 19th, 1939, relating to "Earth-moving Device," is DESIROUS OF ENTERING into ARRANGEMENTS by WAY of a LICENCE or otherwise on reasonable terms for the purpose of EXPLOITING the above PATENT and ensuring its practical working in Great Britain.—Inquiries to SINGER EHLERT, STERN and CARLEBACH, Steger Building, Chicago, Illinois. 8887

THE PROPRIETORS of BRITISH PATENT No. 510,056 are PREPARED to SELL the PATENT or to LICENSE BRITISH MANUFACTURERS to work thereunder. It relates to Regenerators for Furnaces.—Address, BOULT, WADE and TENNANT, 112, Hatton Garden, London, E.C.1. 8888

MISCELLANEOUS

BOUND VOLUMES or COPIES of "THE ENGINEER," January to June, 1932, or January to June, 1937.—Address, 8873, The Engineer Office. 8873

For continuation of Small Advertisements see page 4

A Seven-Day Journal

A "Battle for Fuel" Exhibition

On Wednesday last, October 21st, the Ministry of Information, in co-operation with the Ministry of Fuel and Power, opened an exhibition depicting the "Battle for Fuel" at the Dorland Hall, Lower Regent Street, London, S.W.1. It will remain open to the public daily, including Sundays, until Sunday, November 8th. Every aspect of the fuel-saving problem is dealt with by means of exhibits covering domestic, commercial, and industrial methods of saving fuel and obtaining maximum fuel efficiency. Many fuel-saving hints which have hitherto been difficult to explain are shown by means of models, photographs, and physical exhibits, with experts in attendance to answer all inquiries about such matters as the fuel target, fuel units, and general fuel economy. The exhibition is entered through a full-sized replica of a section of a coal mine, arranged between the entrance and the exhibition proper, through which one must pass. This part of the exhibition is used to demonstrate in various ways the frequently overlooked fact that home-produced coal is the basic fuel from which we derive our supplies of gas, electricity, and also many by-products which are vitally important to the national war effort. In contradistinction to the usually well-lighted exhibition, the present exhibition breaks new ground by utilising new methods of exhibition lighting which have been designed to satisfy the need for strict lighting economy without detracting in any way from the interest of the exhibits. A small theatre has been arranged within the exhibition, in which lectures and demonstrations are given and films shown each day.

Allied Sea Power Maintained

In a speech made at Aberdare on Sunday evening, October 18th, Mr. G. H. Hall, the Financial Secretary to the Admiralty, spoke of the great effort which is being made by Britain's shipyard workers, and the way in which Allied sea power is being maintained. British shipyard workers, Mr. Hall stated, had repaired and refitted 20,000 units of the Fleet and had sent them back into action. On the mercantile side, they had, he said, repaired a gross merchant tonnage of 140,000,000, comprising 35,000 ships, and had put them back into service. Speaking of the recent convoy to Russia, Mr. Hall said that when that convoy got through three weeks ago, the Germans claimed that they had sunk sufficient equipment for an army. He assured his audience that whatever truth there was in that claim, what did get through in the form of motor vehicles, tanks, munitions, and general cargo must have been of amazing value to the Russians in the recent and present fighting. Sea power, without which the fortress of Britain could never be held and which was an essential factor in the victory of the United Nations, remained with Britain and America. Despite three years of war, there had not been, Mr. Hall stated, any depletion in the strength of the Royal Navy at any point. The losses we had sustained in heavy ships had been made up, the strength in small units had increased, while a large fleet of smaller ships had been created which was doing valuable work against the German submarine menace.

Frost Danger to Motor Vehicles

The Ministry of War Transport announces that users of motor vehicles should now take steps to guard against the danger of damage through freezing. A sharp frost is sufficient to cause a cracked cylinder block in a single night, and even a slight frost may result in serious damage in certain conditions. The following advice is offered:—If a vehicle has to stand for any length of time, the best precaution against frost is an empty water system. Before applying for anti-freeze, consider alternative methods, as supplies of anti-freeze are very limited. If no alternative method is practicable, apply for anti-freeze to the appropriate Regional Transport Commissioner, giving reasons why other methods cannot be adopted. Use anti-freeze sparingly. A mixture of one part of anti-freeze and three parts of water should be sufficient for any frost likely to occur in this country. In general, anti-freeze will be available only for essential civilian transport. It will not be available for private cars, except for those of doctors, district nurses, or other persons doing essential work, who, by the nature of their work, cannot take alternative measures. The requirements of the civil defence, police, and fire-fighting services are dealt with by the Ministry of Home Security, to whom inquiries should be addressed. Extra care will be necessary this winter, owing to the increasing difficulty of replacing cylinder blocks, cylinder heads, and water pump components. If, in spite of precautions, one of these parts should be damaged, the possibility of repairing the crack should be explored. The Ministry of War Transport will be pleased to advise on such problems, either directly or through the Regional Maintenance Officers.

The War at Sea

In the course of a speech on "The War at Sea," which was made by Mr. A. V. Alexander, the First Lord of the Admiralty, at the Caxton Hall, Westminster, on Tuesday, October 20th, some interesting figures were given concerning the sinkings and damage done to enemy U-boats. Mr. Alexander said that it might be of interest and some encouragement if he stated that since the war started we had now an actual record of attacks on U-boats which have resulted in the sinking or damage of over 530 Axis submarines. These figures, he stated, did not include attacks made by the U.S.S.R. or by the French Navy before June, 1940, but did include some of the attacks which had been made by our American Allies. These attacks were increasing, but so far no up-to-date returns concerning them were available. Three changes which in particular had occurred in sea warfare since the last war were then referred to. They were, Mr. Alexander said, the greatly increased radius and striking power of aircraft; an immense increase in the endurance and capabilities of the U-boat; and the magnitude and variety of enemy mining operations, including magnetic and acoustic mines sown from the air. It was to counter these changes that the greater part of our effort had to be directed in order to keep our sea communications clear, and in doing so the Navy had sustained most of its casualties. These casualties, unfortunately, had been large, even judged by 1914–18 standards. There had been much discussion in recent months about the second front, but it must be remembered that our ability to secure this depended directly on the degree of control that was exercised at sea as well as in the air. The shipbuilding programmes of America and Britain afforded more grounds for confidence in final victory than any other factor, except the sterling courage of the seamen of both countries.

Tank Design and Production

Answering a question in the House of Commons on Wednesday, October 14th, Mr. Oliver Lyttelton, the Minister of Production, said that machinery which already existed ensured the closest liaison between units using tanks in the field and all concerned with the design and production of the vehicles. These arrangements, Mr. Lyttelton went on to say, were constantly under review by the War Office and the Ministry of Supply, in consultation with himself, with a view to studying the criticisms and suggestions of the Fighting Forces, and ensuring their application in design and production at the earliest possible moment. There were many channels of communication between the tank user in the Middle East and the development of supply in this country. On May 5th last the Secretary of State for War had announced the formation of Operational Research Groups working with the Army in the field. Valuable information was also being obtained from officers returning from the Middle East, while, in addition, representatives of the manufacturing firms have visited the fighting troops, in order to obtain first-hand information as to how their products were behaving and could be improved. We may add here that Sir George Usher has resigned from the position of Director-General of Tank Supply. As announced in The Engineer of September 4th, Commander E. R. Micklem, of Vickers-Armstrongs, Ltd., has been released by that company to serve as Chairman of the Armoured Fighting Vehicles Division and Chairman of the Tank Board of the Ministry of Supply. Another appointment is that of Mr. A. J. Boyd, of the Metropolitan-Cammell Carriage and Wagon Company, Ltd., as Director-General of Armoured Fighting Vehicles Supply, while Mr. Oliver Lucas retains the position of Director-General of Armoured Fighting Vehicles Design.

New Aircraft Production and Air Appointments

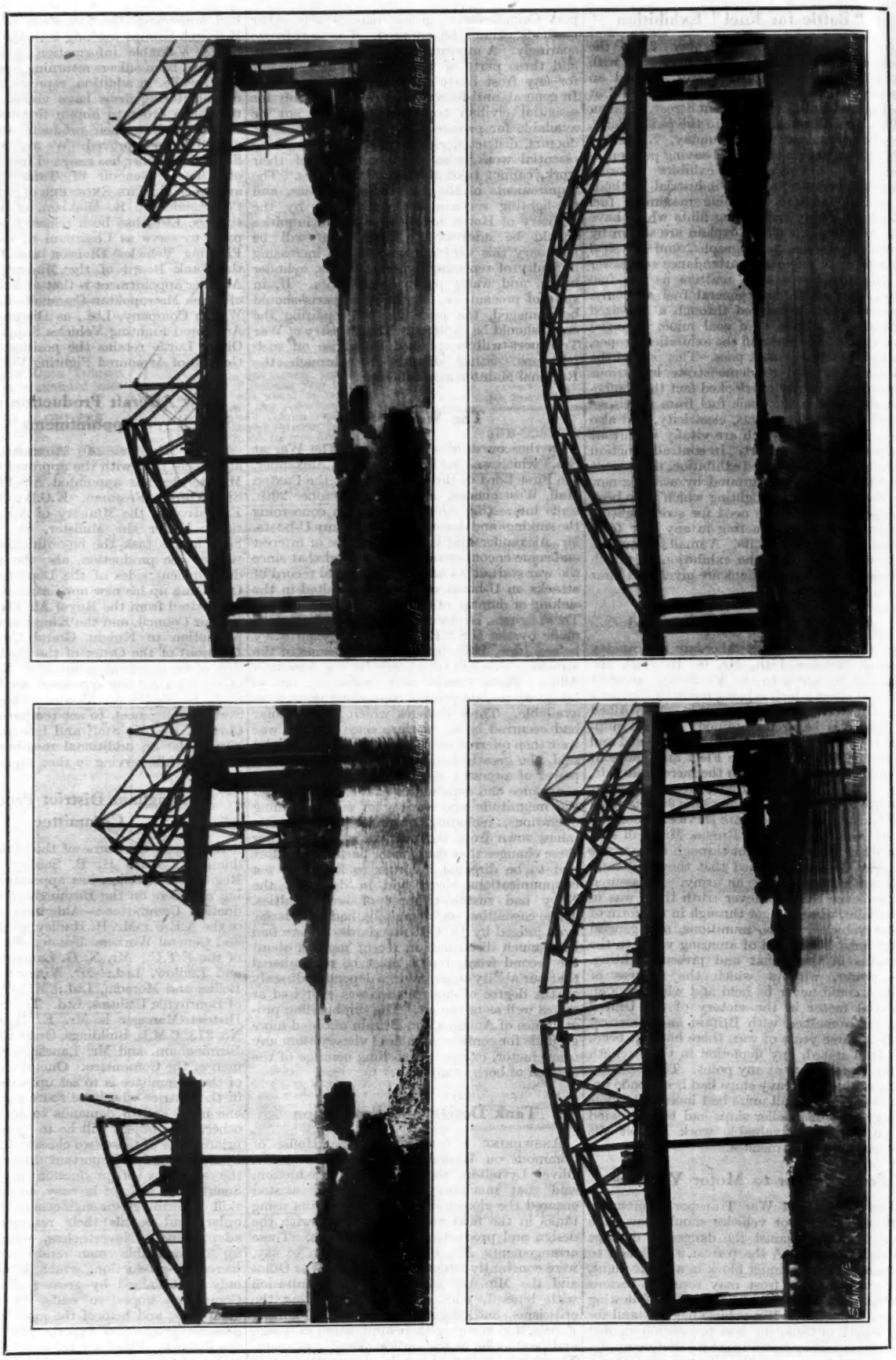
The Minister of Aircraft Production announces that with the approval of the Prime Minister he has appointed Air Chief Marshal Sir Wilfred Freeman, K.C.B., to be Chief Executive at the Ministry of Aircraft Production. Under the Minister, Sir Wilfred will have as his task the co-ordination and direction of the production, also the research and development sides of the Department's work. On taking up his new appointment, Sir Wilfred has retired from the Royal Air Force and from the Air Council, and the King has approved his promotion to Knight Grand Cross (Military Division) of the Order of the Bath in recognition of his outstanding services. The Secretary of State for Air has appointed Air Vice-Marshal C. E. H. Medhurst, Assistant Chief of the Air Staff (Intelligence), to act temporarily as Vice-Chief of the Air Staff and has also appointed him to be an additional member of the Air Council while serving in that capacity.

Birmingham District Production Committee

Acting in the name of the Minister of Production, Colonel H. B. Sankey, who is the Regional Controller, has appointed the following members on the Birmingham District Production Committee:—Alderman A. E. Ager, of the A.E.U.; Mr. H. Hadley, of the Transport and General Workers' Union; Mr. J. T. Bolas, of the E.T.U.; Mr. N. G. Lancaster, of Fisher and Ludlow, Ltd.; Mr. Vincent Everard, of Belliss and Morcom, Ltd.; Mr. W. N. Hallett, of Bournville Utilities, Ltd. The Secretary and District Manager is Mr. E. Beechey, Room No. 313, C.M.L. Buildings, Great Charles Street, Birmingham, and Mr. Lancaster is the Chairman of the Committee. One of the first duties of the Committee is to set up a record of firms in the district who have spare capacity on the one hand and of demands to be filled on the other. The object will be to "marry" appropriate parts of these two classes. A second but by no means less important duty is to improve the efficiency of production in the district. Such a task will not be easy, as the production skill of Birmingham engineers is of a very high order, and equals their resourcefulness and adaptability. Nevertheless, with the drying up of available man and woman power, increased production, which is essential, can only be obtained by greater efficiency. The Committee hopes to enlist the active aid, sympathy, and help of the most able and progressive production experts and engineers in the district. Plans are being developed to this end, and with the support of the works production committees now working in many factories, it is hoped to make a big drive towards greater production at greater efficiency.

ERECTION OF BRIDGE OVER CHESAPEAKE AND DELAWARE CANAL, U.S.A.

(For description see opposite page)



Bridge on Chesapeake and Delaware Canal

No. II—*(Continued from page 316, October 16th)*

THE substructure of the St. Georges bridge is made up of two abutments, one at the land end of each approach, and forty-one piers, all of which are of concrete. The piers which support the main span, as well as those of the approach spans, are twin-shaft structures that rise from massive concrete footings and are connected at the top by a wide and deep strut that varies in dimensions, depending upon the height of a given pier. The struts at each main pier are 8½ft. wide and 15ft. deep, and the clear width between shafts is 37ft.

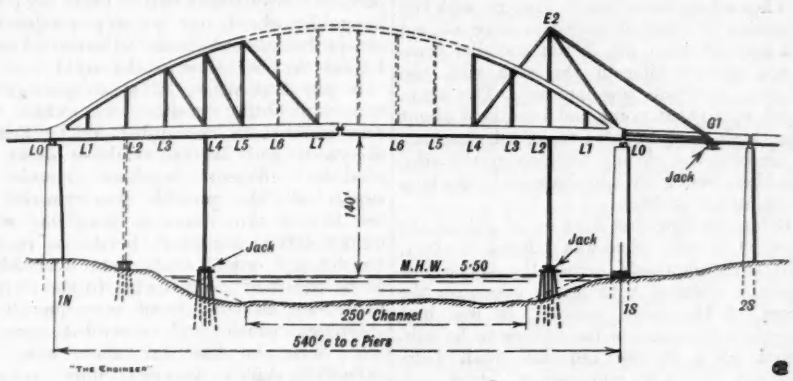
The footings of all piers and abutments rest on piles, and on the higher ground adjacent to the land ends of the approaches the piles are of the cast-in-place concrete type. Nearer the canal ground water close to the surface made it possible to use timber piles, and the two main piers for the canal crossing are set on steel H beam piles. The bases of the two main piers are 50ft. below mean low water, which was considered the highest elevation that would be satisfactory when the channel is ultimately given its maximum width under the main span. Each main pier was reared from within a steel sheet piling cofferdam, and that piling was driven to a depth of not less than 10ft. below the pier footing. When the foundations had been poured, the sheet piles were cut off at the top of the base and the remaining sections were left undisturbed. The same kind of protection was also given the adjacent approach pier on each side of the canal. In this manner and at only a moderate increase in cost, the two main piers are well protected against injury during dredging operations when and if the canal prism shall be deepened to possibly 42ft. and given a bottom width of 500ft.

From the tops of their foundation footings at El. −18·00, the north main pier rises to El. 132·50 and the south main pier rises to El. 131·25, a height of 150·50ft. for the north pier and 149·25ft. for the south pier. The 130ft. approach span and the north end of the main span are fixed where they rest on top the north main pier, but at the south main pier that end of the main span and the adjacent end of the approach span rest on expansion shoes, and a cast steel, toothed, cantilever type of expansion joint is provided for the deck. Because of an overturning effect of a longitudinal load of 346 kips, applied horizontally, through the fixed shoe pins, two additional transverse rows of steel H piles were driven for the north pier, and a similar distinction was made between fixed and expansion piers when designing approach piers. The outer rows of piles in the bases of the two main piers were given an outward batter to increase stability. This was done as a safeguard against temporary unbalanced earth pressures that might be induced when dredging the canal in the future in widening and deepening operations.

Inasmuch as the piers function as vertical cantilevers when resisting longitudinal loads, they are accordingly reinforced. The horizontal struts act with the shafts as a framed bent in resisting transverse loads, and are reinforced as required by the bending moments induced therein. The two main piers rise in each case from a single base, but each shaft of each approach pier has its own base with a transverse strut at the bottom of the twin shafts, wherever an approach pier is more than 75ft. in height. The bottom of the shafts generally is below ground surface. Each of these struts was added because the pier bases otherwise would be excessively wide, due to large moments produced from transverse loads. As Mr. Quade has pointed out: "The struts have been proportioned with regard to the interaction between the bottom strut and the bases, so that when the strut is fully stressed to allowable unit stresses the maximum deflection of the outer rows of piles, due to rotation of the ends of the strut, does not exceed $\frac{1}{16}$in., and therefore is well within the limit of elastic action of the pile. In piers that have no bottom strut, points of contraflexure were assumed at about the lower third point of the shafts, based on a detail study of a typical pier. The maximum unit stress used for concrete subjected to a combined bending and direct stress, with wind included, is 700 psi. This intensity occurred at the top of shafts where transverse wind moments are large. At the bottom the shafts were designed for 450 psi. or less, with the additional requirement that the bending stress from all sources should not exceed the direct stress by more than 100 psi. when expressed in terms of a homogeneous material. Sections that are critical for diagonal tension are proportioned for a shear of 50 psi. or less to avoid web reinforcement. The maximum unit stresses in the reinforcing steel are 18,000 psi. for dead plus live load, or for dead plus wind load, and 22,500 psi. for combined dead load plus live plus wind loads."

The main span piers are not situated equidistant from the centre line of the present channel of the canal, and the north pier rises from higher ground and farther back from the waterway than is the case with the south main pier. That situation necessitated recourse to different methods in erecting the two halves of the main span, because the Army engineers would not permit the use of any falsework that might intrude upon the existing channel, which has a bottom width of 250ft. The falsework bents employed for the north half of the span were located at two positions southward from the north pier as erection proceeded. The south falsework bent was located under panel point No. 2, and when the remaining sections of the southern half of the span were carried northward over the canal, a tie-back tower, 100ft. high, with tension diagonals from the top of the tower to panel points Nos. 4 and 0 and to anchorages on the adjacent approach girder, was used to sustain the steelwork. The erection tower and each of the falsework bents were equipped with hydraulic jacks to control movements of the structure during closure and to verify by occasional readings of the pressure gauges and by adjustment of shims to control the reactions during the stages when the structure became statically indeterminate externally.

Using temporary diagonals in the north half, cantilever erections beyond panel point No. 4 followed a normal procedure outward to mid-span. In addition, the hangers were for the time being reinforced to meet compression stresses. A further precaution was a temporary sway frame at panel point No. 4, which served to transfer lateral loads on the top chords of the arch to the supporting falsework bent. A 150-ton A frame traveller, that had been used previously in erecting the 1842ft. north approach, did the erecting of the north half of the main span. For the south half of the main span another 150-ton A frame traveller, earlier used in erecting the 1827ft. south approach, handled the steel outward to panel point No. 4 of that section of the crossing. From panel point No. 4 south, outward to mid-span, a 75-ton traveller finished the work. Steel for the tied arch span was delivered by trucks at the foot of each main pier, hoisted by the travellers, and carried to the required positions, either in falls or on dolly cars. In the case of five sections over the channel, the steel was lifted from barges that were spotted below in the waterway.



METHOD OF ERECTING MAIN SPAN

The north half of the structure, which was erected wholly by cantilevering, was so stiff that the ends of the tie girders, with all steel in place, were deflected but 1½in., whereas the south half, because of the length of the cantilevered tie girders, was extremely flexible, and, had it been cantilevered complete to midspan, would have deflected 28½in. However, it was not practicable to cantilever the entire south half, and to have attempted to do so would have necessitated a much more extensive and heavier tie-back system. The tie-back system adopted was designed to cantilever beyond panel point No. 4 south only the load of the tie girders and their bottom lateral system, and to hold them until some of the load could be transferred to the northern half of the arch by connecting the tie girders by means of a temporary pin. To effect this initial connection, the south half of the span was aligned with the north half by means of the hydraulic jacks, and with the southern tie girders erected to panel point No. 6, the first closing section was held in the falls while the splice at panel point No. 6 was completely fitted up. With that done, the section was hoisted just enough to bring the pin holes in its northern end to the same elevation as the holes in the section to which it was to be connected, and then held there on the edges of the web splice

plates while the closing section of the other girder was erected. With these preparations finished, the two halves of the main span, before then kept about 6in. apart horizontally to admit the closing sections of the tie girders, were brought together and the pins driven. Inasmuch as the north half of the span was fixed at its main pier, all movement leading to closure was made by jacks that controlled the south half of the arch.

After this preliminary juncture was made, there had to be some provision for taking care of expansion and contraction at the south end of the crossing. The anchorages of the tie-back system were designed to meet such a contingency. It was necessary at the same time to provide at the south pier reaction for wind loads on the span, despite the fact that the span did not bear there on its expansion shoes, and would not do so until it was swung. For this purpose a vertical steel cantilever beam was embedded in the pier and the beam engaged, much like a tooth, temporary transverse bearing seats on the bottom of the end floor beam. A kindred beam had been employed at the north main pier owing to the lateral instability of the shoes there during stages when a small measure of uplift occurred at the main pier. That uplift was resisted by long anchor bolts through the shoes, that were extended temporarily by sleeve nuts and rods to engage the trusses.

When all splices in the tie girders, with the exception of those at midspan, were aligned and riveted, then the 75-ton traveller completed the erection of the arch ribs, the hangers, and the top laterals. The span, which up to that point had been held about 12in. high at the centre to afford clearance in erecting the closing sections of the ribs, was then swung by simultaneously slacking off on all the jacks.

Before riveting was done in the splices the moment in each splice was reduced to about zero, and alignment across the splice was carefully checked with levels taken on the girder at the panel points. It was first necessary for some of the splices to be subjected to a reverse moment, with bolts loosened, so as to eliminate a "kink" in the alignment. The care taken was justified, and at no point does the sweep of the tie girders deviate to any appreciable extent from a smooth curve. The concrete deck work was not begun until all riveting had been completed, and the sequence of that work was arranged so as to avoid overstressing the tie girders by unsymmetrical loading.

Agreeably to the suggestion of the architectural consultant, Aymar Embury II, the tops of the main piers are completely enclosed with corrugated asbestos cement board up to the deck level, and it is attached to light steel framing anchored at the top of each pier. Two ornamental pylons are placed on the ends of each of these pier enclosures, outside the railing at the corners of the main span. The pylons are star-shaped in section and have a slender finial in each case. The pylons rise 20ft. above the roadway and are made of aluminium and glass, and are illuminated by light strips, 12ft. in height.

The Chesapeake and Delaware Canal, as a waterway, is much superior to the property purchased by the Government in 1919, and to-day, with its improved and deepened approaches, has a total length of about 21 miles. Independently of the cost of the new bridge, approximately 2,747,000 dollars, this valuable section of the intracoastal waterway has cost the nation more than 25,000,000 dollars.

The substructure of the new St. Georges Bridge was built by the Penker Construction Company, Cincinnati, Ohio, and the superstructure was by the Phœnix Bridge Company, Phœnixville, Pa., with the Corbetta Construction Company, Inc., of New York, as subcontractors for the concrete deck. The approach roadways were constructed by George and Lynch, Wilmington, Del.

The crossing was built for the United States Government under the direction of the Corps of Engineers, U.S. Army, with Lieut.-Colonel H. B. Vaughan, District Engineer of the U.S. Engineer Office at Philadelphia, as the contracting officer. General supervision of the field work for the Corps of Engineers was under H. N. Crichton, principal engineer, with office at Chesapeake City, Md.

Plans and specifications for the project were prepared by Parsons, Klapp, Brinckerhoff and Douglas, who had made a preliminary report in 1939, and in the New York office of that engineering firm, the designing work was under the supervision of E. L. Macdonald and Maurice N. Quade immediately in charge. Shortridge Hardesty was associated in the engineering design, and W. H. Bruce was resident engineer.

British Shipbuilding*

By J. RAMSAY GEBBIE†

IT is crystal clear that ships are the Allies' prime necessity to-day even more than in the last war, and to-night we may ask ourselves the questions: "How does our industry stand, and are we doing everything humanly possible to produce the very last ton of shipping which our shipyards are physically capable of building under total war conditions?"

I shall deal principally with merchant ships, because it is obviously impossible to say much in public about our warship production, except that when the facts can be made known I think they will surprise the world.

In the first place, let us examine what our shipbuilding position was when war was declared in September, 1939. British shipyards had berths available easily to produce sufficient merchant vessels to supply all the possible requirements of the British shipowners in peacetime with, unfortunately, far more berths in reserve for foreign orders than were ever likely to be obtained; but, owing to the terrible depression in trade, and consequently in shipping, which had prevailed practically since the last war, there were not sufficient skilled workmen fully to man all the berths available. Further, the outbreak of war necessitated a proportion of the berths which would have been available for merchant ships in peacetime being utilised for the construction of warships and fleet auxiliaries, and a large number of workmen being diverted to repair the great damage inflicted on our ships by enemy action.

The shipbuilding capacity in berths and men therefore remaining for ordinary new merchant ship construction was limited, and could never be expected to be used for a large mass-production programme. While the plant and berth capacity has always been in excess of labour supply, these two determining factors have been more appropriate to a programme of replacement of many important types. In the United States, however, the position was quite different, as, after providing for special needs, they had in man power a large capacity left which could be used for an extensive mass-production programme as fast as the necessary facilities could be provided. The British Government, therefore, and I am sure wisely, arranged not only for large numbers of ships to be built for us in U.S.A., but also had two new shipyards laid down where the then unlimited supply of labour and material available could be utilised on the spot. As America had only a very limited supply of riveters and similar skilled shipyard tradesmen available, the Admiralty, recognising the ease with which electric welders could be taught, took the bold decision to build welded ships, although the vast majority of the men who would be employed on the building were quite without any shipyard experience. It was a bold decision and, fortunately for us, it has proved to have been a sound one, as the American welded ships now sailing the seas are proving to be good and reliable vessels; but I would like to emphasise now that the one and only reason for the American ships being welded instead of riveted is that welding labour was available, or could be quickly made available, while riveting labour was not obtainable. To listen to the clamour from the uninitiated for welded ships to be built in this country, one would think that the welded ship, *per se*, could be built in half, or less, the time that it takes to build the ordinary riveted article; but this is definitely not so, and the reasons which allow of the Americans launching a ship in less time than we can do are peculiar to the existing conditions.

The Americans have, especially on the West Coast, much more favourable climatic conditions than we have and, a matter of supreme importance, they have no "black-out"; they are thus, with their enormous labour force, able to work a three-shift system, so allowing them to concentrate on the average about 2000 men on each berth (and, I believe, in some cases approaching 4000) instead of only about 200–300 men in Britain in the case of similar ships, even when such numbers are available. But the United States, not forgetting Canada also, are all doing a magnificent job, and we wish them God-speed in it.

We may now ask ourselves if we have succeeded in reaching the target we set out to attain in 1939, and I can unhesitatingly answer, "Yes!" with the knowledge of the facts available to me. Unfortunately, it is not possible to give actual figures of tonnage produced, but practically every shipyard I know of has broken its past record, and this despite the great handicap of the black-out, the continued stress on the workmen due to war conditions, and the inevitable loss of freedom of movement, restricted transport facilities, and all the other annoyances which in ordinary times would have caused a great turmoil. The industry has been much criticised in the Press and in Parliament, and sometimes, unfortunately, by people who should know better, and I want to deal shortly with some of these criticisms.

National Shipbuilders Security, Ltd.

It is still being stated that N.S.S., as it is called, is responsible for our present inability to produce more ships. Such statements are totally contrary to the facts. The truth is well known to the majority of the shipbuild-

* Presidential Address, N.E.C. Inst., October 16th.

† Managing Director, William Doxford and Sons, Ltd.

ing and engineering members present, so I would explain that, as President, I am making my Address an opportunity for informing the great lay public.

During the last war many shipyards laid down additional berths and entirely new yards were constructed to deal with the serious shipping position which had arisen owing to sinkings and the demands of our Allies for ships, with the result that, when normal times arrived, quite apart from the abnormal periods of depression, the number of berths available was many times greater than required to build the ships for which orders could be, or were ever likely to be, obtained. Obviously, ordinary private firms could not long continue to exist if few or no orders were available, and gradually their financial resources were exhausted and bankruptcy stared them in the face.

What, then, was to be done?

In my submission, there were two alternatives available. One was for the Government to assist shipowners in scrapping the older and less efficient ships and in replacing them by new and up-to-date vessels, while they could also have proceeded right away to modernise the Royal Navy, which would have enabled at least a large proportion of the yards to carry on until expanding world trade might have enabled them and the shipowners to keep going by their own efforts. The second alternative was to reduce the number of yards and berths to something more in keeping with the numbers of orders for ships which a careful survey of the future requirements of the nation had shown to be probable.

The country and the Governments in power at that time, however, were in no mood to assist shipping and shipbuilding, and, as regards the Navy, the policy of all Governments was to persuade other nations to agree to limitation of their navies and their armaments.

The position of our industry was clearly and fully explained to the Governments on numberless occasions, but all in vain, and it was only then, in a last-minute effort to save at least a part of the industry from total extinction, that N.S.S. was formed by the shipbuilders to purchase yards whose owners could see no prospect of their ever again being able to obtain sufficient orders even to pay their way, and to concentrate building in the remaining yards, which were of ample capacity to deal with any possible demand in peacetime. "Sterilisation of shipbuilding sites" has been one of the chief charges made against N.S.S. The words suggest something maleficent, and the ridiculous inference has been made that the aim of the shipbuilders was actually to build fewer ships. To ensure, however, that the industry could be expanded in an emergency they put certain yards on a "care and maintenance" basis, and looked after and maintained their plant in good condition for many years. In fact, nearly two dozen N.S.S. yards have been opened up since war commenced, and are now producing ships and craft so far as available labour will permit, and this, despite the fact that even to-day there are merchant building yards in some districts which could still absorb thousands of additional men; in fact, it would seem that care has been taken by the Admiralty in opening out old yards to ensure that at all times the plant and berths and means generally of building ships have been kept well in advance of the amount of labour available after the demands of the Services and other vital industries have been satisfied.

I have myself listened to many severe criticisms of N.S.S. and its members by trade unionists, M.P.s, and others, but I have never yet found one who could give a rational answer to the question as to what they themselves would have done when the various Governments utterly refused to assist in any way and washed their hands of the industry. Where were these same people when in 1933 the total demand for the services of the industry amounted to no more than 133,000 gross tons, and that in the absence of warships, or in 1938 when only 250,000 gross tons were ordered from the industry?

I make bold to say that if N.S.S. had never been born less rather than more ships would be being produced to-day, because some of the yards which were enabled to survive by the operations of the N.S.S. would have been out of existence long ago.

Types of Ships and Speed

It has been and is being said that we are building the wrong type of ship for wartime purposes, and that owners are thinking more of after-the-war than of winning the war; and these critics aver that, instead of, say, 11–12-knot vessels, we should have gone in for 15–16-knot vessels. In the first place, the shipowners must be largely absolved from this charge because they were only permitted to build what the Government consider essential for war purposes. To the critics, mostly ill-informed, who urge the higher speed proposal, the answer is quite simple, and I instance the position of a particular firm who are to-day completing sixteen 11½-knot cargo vessels of 10,300 tons deadweight per annum. If that firm were directed to build instead 15-knot vessels of the same dimensions (and their berths will not permit of anything much bigger), then the power of the engines would require to be increased from 2900 I.H.P. to over 7000 I.H.P., with the result that the firm could produce only ten of the faster ships per annum, and these would carry only 8300 tons of deadweight instead of 10,300 tons each. In addition, the firm are producing a further eight 2900 I.H.P. engines for other shipbuilders, but if they have to build 7000 I.H.P. engines they could supply no engines at all for other yards. In other words, it is either twenty-four 2900 I.H.P. engines or ten 7000 I.H.P. engines per annum.

I leave the remainder of the arithmetic to the critics! I think the critics should give the Government, who are assisted by expert advisers, and the shipbuilders who are experts in their own business at least, the credit of not being entirely devoid of intelligence. Moreover, from what we see round about us, it is obvious that the programme of fast vessels is not so small as the critics think.

New Types of Shipyards

In this connection we have the type of person who has proposed new kinds of layouts for shipyards on the lines of the production belt, &c.; but, quite apart from the very long time it would take to build such shipyards and the problem of where the additional labour is to come from (we are told by the Ministers of the Crown that we must expect to lose many of our younger men from the yards to the Services), surely the sponsors of these schemes should, first of all, ascertain how our existing shipyards in this country compare with the latest type of yards that have been laid down in the United States. If they would do this, they would find that the existing type of yard has done things that are really meritorious so far as time is concerned, and that, as I have already said, so far as they have absorbed man power on the normal method of building ships, we are well ahead in comparison with the best of any such kind of lay-out.

Standardisation of Design

It is said that all cargo shipyards, for instance, should be building exactly the same standard ship. This method was adopted in the last war and, after a full experience of its working, it was decided that it would be much the better plan to allow each individual yard to concentrate on its own particular standard type as in production before the war. Technical people need no explanation of the reasons for this decision, but, as this Address is read by others, I would explain that different yards have different plant and facilities and different methods of construction, and that the sizes and shapes of plates and sectional steel suitable for one yard would be quite unsuitable to another yard. For this reason standardisation as between yard and yard is, I feel sure, definitely disadvantageous to production, but standardisation within each yard is absolutely essential to quick output, and I am completely satisfied that the present plan is the right one.

Fabrication

There seems to be an idea abroad that all ships in America are constructed in parts far away from the yards and transported to them for assembly, and it is advocated that the same method should be adopted here. If a yard has the space, plant, and labour to fabricate the parts inside its own boundaries and close to the berths, I cannot see why it should be an advantage to fabricate the parts miles away and to burden the railways and the roads with the transport of very large and unwieldy parts; but I am afraid "fabrication," like "standardisation," is a word which has become that horrible product of the modern world—a slogan. In actual fact, those yards which are able to erect and launch more steel than they can themselves prepare have been supplied with large quantities of fabricated parts made by the constructional engineering firms all over the country under the scheme organised by the Department of Merchant Shipbuilding and Repairs at the Admiralty, and many other parts, such as masts, derrick posts, tanks, &c., have also been standardised and are being fabricated at inland works. I believe that, up to the present, 50,000 tons of fabricated steel for ships has been supplied by the constructional engineering industry.

Finally, have the critics of our British production any idea of the enormous increase in the amount of work entailed in fitting-out and finishing-off a ship to-day, as compared with in normal times, by reason of the defensive and offensive armament and other alterations and additions entailed by the intense and scientifically conceived attacks of the enemy by submarines, mines, surface raiders, bombers, &c.? It is not, of course, permissible to give details of all this extra work, but the fact that the extra weight due to defence measures in an ordinary cargo ship amounts to nearly 200 tons will convey some idea of its magnitude, and it is remarkable that the shipyards have been able to complete the ships in the short time they have been doing.

It is extraordinary that the shipbuilding industry should require to be defended against attacks by the politicians, who, for many years before the war, ignored the repeated warnings which the industry gave to them, and who gave us not a vestige of help or even sympathy until, as late as March, 1939, when war was inevitable, they at last decided to provide a scheme to encourage the building of ships. The amount of help was small, but it drew little save abuse of the shipowners from some of the very people who are the critics of to-day. The result, however, was sufficient to enable the shipowners to place enough orders to fill a fair number of the merchant building berths in the country, and to give the industry a flying start, even if a modest one, on the outbreak of war.

When the full story comes to be told, when the integration of the enormous output of new warships, together with the phenomenal extent of repairs and conversions, also the fine contribution of new ships from the merchant yards can be seen as one huge whole, I have no doubt of the appreciation that will then be made of our industry's war effort.

The Future of British Shipbuilding

So much for British shipbuilding in war; but what about the future? I fear we dare not say that we can to-day even attempt to forecast when the conflict will end, and I think you will agree that it must be left to some future Presidential Address to deal with the colossal and unforeseeable problems which I am sure we shall find ourselves confronted with in the post-war world; but I do feel that sufficient leisure is still left to us in which to ponder on these problems, and I would suggest to the heads of the shipbuilding industry, to the leaders of the great trade unions, and to the employees, that they should use their spare moments in an attempt to divide their minds into two compartments, one of which will necessarily be filled with the problems of the present, and the other, empty to-day, but riveted and caulked—or shall I say welded?—to be gradually filled with completely fresh and new thoughts and ideas ready for the ultimate test to come.

I am convinced that if we attempt to conduct our industry in the new world on the basis of the old, with its burdens of agreements, customs, and inequalities which have been built up during a hundred years, we shall fail entirely, and the fresh minds in other countries will win the shipbuilding peace. Is it too much to hope for that all concerned should sit down together and work out sanely and scientifically a "new order" for our industry in which the main references would be to ensure maximum economy and efficiency in construction and production combined with reasonable emoluments for all concerned, from top to bottom, based on the value of the services performed by each individual? Past practices, and emoluments based on past customs, should not, in my opinion, be a main factor in determining future conditions.

Am I advocating a Utopia? I trust not, as the only alternative may be an Inferno!

Air Force Targets

No. XXIX—(*Continued from page 91, July 31st*)

The Creusot Works

THE attack made on the Schneider armament works at Le Creusot, on Saturday evening, October 17th, is outstanding, as forming one of the heaviest daylight attacks carried out without fighter escort during the present war. No less than ninety-four "Lancaster" heavy bombers took part, and only one did not return. The attack was carried out with astonishing speed and the damage done was considerable. The first bomber arrived over Le Creusot at 6.9 p.m., and, according to the Air Ministry News Service, the first bombs fell exactly at the time arranged. The later squadrons arrived rapidly, one after the other, and the last bomb was dropped only 7 min. after the first. The main force, which was led by Wing Commander L. C. Slee, dealt with the works, while another formation attacked the Henri Paul electric transformer station, which is situated about 5 miles from Le Creusot. This station supplies not only the works at Le Creusot, but also other works in the vicinity, besides providing power for the German power network, which at this point is carried up to the frontier, not far distant from the Le Creusot district.

The attack was carefully timed in order to enable the bombers to be over their target in daylight, and yet have the cover of darkness for the return journey. The homeward trip was safely made by ninety-three of the ninety-four bombers which took off, and during the return flight one of the "Lancasters" shot down two out of three attacking "Arado" float-planes. The machine lost was one of the small number of machines which were detailed off to attack the Henri Paul transformer station, which is situated a few miles from the main works. From the reports, given by the crews of other returning bombers, it would appear that the loss of this machine may not have been due to enemy action. While the bombing of the main works was done from heights of from 4000ft. to 6000ft., the machines over the transformer station came down to a height of only 500ft., and it is thought that some of the flying *débris* may have hit the "Lancaster" as it passed over the target. In the outward flight the great majority of the force hedge-hopped across France, and only climbed to bombing height on reaching Le Creusot. As already mentioned, they had to fly home and land in darkness, many of them away from their own bases. This they did so successfully that, as Air Marshal Sir Arthur Harris said in a congratulatory message to the crews, they arrived "without bending a rivet."

The town of Le Creusot is not particularly easily found under night flying conditions on account of its few landmarks and the congested nature of the target. It was decided to make a daylight attack, on a Saturday evening, with the object of ensuring an accurate attack with as little damage and injury to the French civilian population as possible. The official loss of life and injury, referred to by Vichy in broadcast announcements, is given as 57 dead and 250 injured, figures which, however regrettable, bear witness to the accuracy of the actual bombing.

Position and Historical Associations

As will be seen from the accompanying part view of the works and the plan, the Creusot works and those at Breuil occupy the bottom of a well-wooded valley, along which they extend for a distance of something over 2½ miles. The older part of the Creusot works are situated at the eastern end of the valley, while the Breuil steel works are at its western extremity. The two works do not lie in a straight line with each other, but, as our plan shows, are placed at an angle. The older portion of the works includes the coal and ore bunkers, the blast-furnaces, and the coke oven and by-product recovery plant, along with the steel works, the foundry, and the forge departments and the central power station. The plan of the works we reproduce is taken from a sixteen-page illustrated Supplement to The Engineer, which was published with our issue of September 17th, 1920, following a memorable personal visit paid to Le Creusot. There is no doubt that some plant alterations have been made during the last twenty-two years, particularly as it was intended to move the blast-furnace plant from its original position in the old works to a new position further down the valley, with the object of supplying the Breuil steel works with liquid pig iron instead of charging in the old way with cold pig. The actual present position of the blast-furnace plant, however, does not really matter as regards its target value, as in any case with daylight bombing the outlines of the blast-furnaces and their stoves would be clearly seen.

The Breuil works consist of a large steel-melting department, with its rolling mills, machine and fitting shops, and the gas producer plant, with a huge stockyard. In between the two works are the heavy rolling mills, a turbine erecting shop, and extensive shops for the manufacture and assembling of locomotive parts, together with a locomotive erecting shop.

View of Part of the Creusot and Breuil Works

Some 8 miles further down the valley and connected with the Creusot and Breuil works, are the Henri Paul works at Montchanin, which were named after the eldest son of Mr. Eugene Schneider, who was killed during the last war. They are connected both by rail and by canal with the Creusot and Breuil works, and comprise large iron and bronze foundries, with their pattern shops and stores. It is in this part of the valley

that the Henri Paul transformer station is situated. It took power from the outside power supply company for some of the works, particularly the Breuil and Henri Paul factories.

The group of three works we have referred to occupies an area of over 3000 acres, served by some 80 miles of railway track and sidings. Many thousands of workpeople are employed.

The history of the works at Le Creusot dates back to the opening of the sixteenth century, when coal was discovered in the valley in 1502. It was first worked in surface outcrops for about 250 years, and later in mines, which in present times were largely worked out. It is of historical interest to record that in 1786 the celebrated Sèvres Glass Factory was transferred to Le Creusot and continued to work there up to the year 1832. Part of the old factory has been converted into the Chateau de la Verrerie, Mr. Eugene Schneider's country seat at Le Creusot, which, together with its surrounding park, lies due south of the older portion of the works and overlooks the original site of the blast-furnace plant. In the courtyard of the chateau there still stand two of the old glass kilns, having a domed-shaped structure larger in size than the Staffordshire pottery kilns, but of similar form. One of these kilns is now a chapel, while the other has been converted for use as a private theatre for the chateau and its guests. The town itself is situated on a branch line of the P.L.M. Railway, which runs from Nevers to Chagny, a station on the main Paris and Lyons line. It is 238 miles from Paris and about 25 miles east of Chagny. It forms the main town of the *arrondissement* of Autun, in the Department of Saone-et-Loire, and is linked with an important waterway, the Canal du Centre. Le Creusot forms a large and straggling town, which lies on each side and behind the Parc de la Verrerie, and continues spasmodically wherever the exigencies of the growing works allow room for habitations. It contains several fine schools, hospitals, and other buildings, all of which were erected and maintained by the Schneider family. The population, which is probably about 50,000, is housed in, for the most part, roomy and substantial workmen's dwellings and well-planned garden suburbs.

Any reference to Le Creusot would be incomplete without mention of the personal interest taken by Mr. Eugene Schneider and his family in the welfare of those working for the firm. The whole of the administration and co-ordination of these numerous welfare activities for the workpeople and employees and their families was conducted at the Paris office of Schneider and Co., and was the constant occupation of Mr. Eugene Schneider and his family, whose personal solicitude for the well-being of all employed in his many works contributed in no small measure to the excellent relations which always existed between the firm and its employees.

Some Works Particulars

Those who wish to study the more detailed equipment of the various works we have mentioned should consult our Supplement of September 17th, 1920, but in what follows we give some guiding particulars.

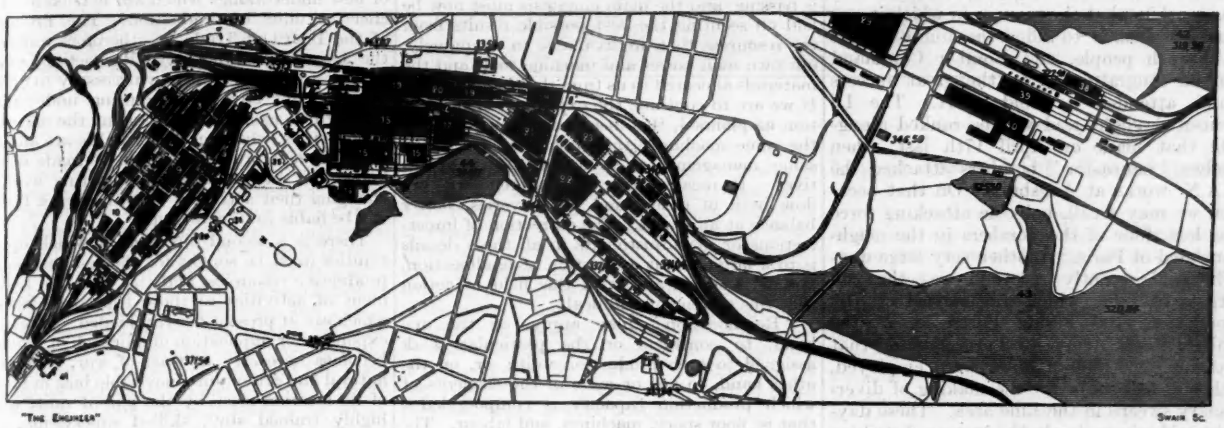
The blast-furnaces at that time included up-to-date plant with furnaces of 125 to 150 tons daily capacity, together with a sintering plant for the use of briquetted iron pyrites, Spanish hematite, and mill cinder and scrap. The blowing engines originally comprised gas and Corliss engine-driven blowers, with Rateau turbine-driven blowers. The coke oven plant was of the Coppee regenerative by-product type and many by-products useful to the chemical industry were recovered. The central power station included both Babcock and Kestner boilers, designed for gas or mechanical stoker firing, and supplied steam to the engine-driven blowing engines and turbo-compressors and to a series of Schneider-Zoelly turbines. There were two steel furnace shops, complete with basic and acid open-hearth plants, and electric furnace equipment. The steel foundry at Le Creusot was considered to be one of the largest of its kind in Europe, and had an annual capacity of about 15,000 tons of castings. It occupied an area of 30,000 square yards, and was situated in a building with eight bays served by travelling and shop cranes. The rolling mill equipment comprised a general sheet and bar mill, an armour plate mill, and a boiler plate and tyre mills.

The forging department was always famous for the large number of steam hammers and hydraulic presses it contained, many of which were specially designed and equipped for the rapid manufacture of gun forgings and armour plate, and the production of shell billets.

The engineering shops were among the most important in the factory and were employed on gun work, turbines, locomotives, and boilers. The shops had an area of over 42,000 square yards, and contained more than 600 machine tools, some of them very large ones.

The importance of the locomotive shops may be gauged by the fact that in 1920 they were designed for an annual capacity of 300 large locomotives. They covered an area of 65,000 square feet The assembling shop had three parallel bays, each 200ft. long, with three lines of rails, accommodating thirty locomotives under construction at the same time, in addition to which there were a painting shop and a test shop. The new Creusot boiler works covered an area of 24,000 square feet and were equipped for the production of 300 large locomotive boilers per year.

The Breuil steel works were designed and built during the last war and contain modern plant, which, we believe, like the rest of the works, has continually been kept up to date. It included open-hearth furnaces of the basic and acid types, laid out in a well-arranged melting shop, complete with Wellman-Seaver chargers. The gas producers were of the Hilger pattern. The casting pits consisted of a bay, 776 yards long and 72 yards wide, with an ingot-stripping and dressing shop. The rolling mill plant at Breuil had a designed capacity of 400,000 tons of blooms, 100,000 tons of billets, 60,000 tons of finished steel sections, 70,000 tons of plates, and 30,000 tons of strip. The plant con-



"The Engineer" Swain Sc.

1. Offices.
2. Steel works.
3. Steel foundry.
4. Light forging department.
5. Colliery shaft.
6. Foundry machining shop.
7. Blast-furnaces.
8. Coke ovens.
9. Boiler and locomotive shops.
10. Central power station.
11. Shaft.
12. Shaft.
13. Benzol and by-product plant.
14. Locomotive shed.
15. Rolling mills.
16. Tyre mill.
17. Bar stores.
18. Gasworks.
19. Heavy forging department and armour plate bending shop.
20. Large gun hardening pits.
21. Turbine building shop.
22. Locomotive building shop.
23. Locomotive erecting shop.
24. Proving ground.
25. Shop for shrinking hoops on big guns.
26. Fitting shops.
27. Stores and offices.
28. Locomotive painting shops.
29. General machine shops.
30. Small steel castings.

Above 29 not shown.

31. Chateau and Park.
32. Statue of Mr. E. Schneider.
33. Church of St. Laurent.
34. Town Hall.
35. Schools.
36. Post Office.
37. Station.
38. Warehouses.
39. Breuil steel works.
40. Sheet and bar mills.
41. Garage.
42. Breuil Lake.
43. Torey Lake.
44. Forge pond.

THE WORKS AT LE CREUSOT

sisted of electrically driven cogging, bloom, large billet, bar, and strip mills, with the necessary reheating furnaces and Morgan producer plant.

The Henri Paul works at Montchanin, previously referred to, comprised the largest iron and non-ferrous metal foundry in the world, extending over an area of 275,000 square yards, of which over 75,000 square yards were covered with buildings containing modern foundry plant.

Enough has been said to indicate the importance of the target, for Bomber Command in its continual striving to cripple the German war effort. The Le Creusot works were undamaged when the German armies entered France, and were doubtless spared in order to preserve them for an eventual addition to the outputs of armaments made at the Krupp and Skoda factories.

No less important to a greatly strained German railway position was the supply of locomotives and railway equipment which was being produced at the Le Creusot factories. Their bombing was necessary on account of the direct aid they were giving to the German war machine, but the manner in which it was done was such as to inflict the minimum loss on French people, and Bomber Command can be congratulated on the great success which attended its bold effort. The Le Creusot daylight raid will be ranked alongside that made on April 17th last, when twelve "Lancaster" bombers attacked the M.A.N. works at Augsburg. On that occasion we may recall, half the attacking force was lost, four of the bombers in the neighbourhood of Paris. Another very large daylight raid recently recorded was that on targets at Lille, which was carried out by more than 100 Flying Fortresses of the United States Army Air Force, but on that occasion over 500 fighters were employed, either as escorts or for the making of diversionary sweeps in the Lille area. These daylight raids show clearly the increased striking power of the Air Forces of the United Nations.

Obituary

ALEXANDER JAMES THORNTON

We regret to have to announce the death suddenly at his home in Brooklands, Cheshire, of Mr. A. J. Thornton, managing director of A. G. Thornton, Ltd., manufacturers of drawing and surveying instruments, slide rules, and drawing-office equipment, whose works are in Manchester. The business owed its origin to Mr. Thornton's father, Mr. A. G. Thornton, whose death took place in 1910. In 1912, after being engaged solely in the production of hand-made drawing instruments, Mr. A. J. Thornton foresaw the necessity for more modern methods of production by the arrangement of machine tools and presses, and he took over premises in Hulme, Manchester, for this purpose. It was not, however, until 1917 that production really started, owing to the requirements of the Ministry of Munitions. Since that time many improvements have been effected in this branch of the business, and this has increased until the firm of A. G. Thornton, Ltd., now claims to be the largest manufacturer of drawing-office equipment in the British Empire. Mr. Thornton, in the early part of this century, saw the advantages of the Log Log scale for slide rules, and introduced the first rule of this type to the market. This rule was formerly manufactured on the Continent, but in 1925 Messrs. Thornton took up its manufacture in Manchester, and many other improvements were introduced, such, for instance, as the differential scales applicable to the Log Log and trigonometrical scales. Mr. Thornton was in his sixty-second year, and leaves two sons, one of whom is an air pilot and the other is carrying on the essential business.

Allocation of Production Resources

On Wednesday, October 14th, Mr. Lyttelton, Minister of Production, made a statement in the House of Commons in reply to a question by Mr. Greenwood concerning the more efficient allocation of production resources. The following statement was later issued by the Ministry to illuminate more fully what Mr. Lyttelton had said in the House.

The war production of this country, with that of the U.S.A., Canada, and the rest of the Empire, must be planned as a comprehensive whole; but in this country, taken by itself, the period of widespread expansion of resources is passing, and the main emphasis must now be laid on securing the best possible results from the resources that are available to us, namely, our own man power and machine tools and the materials allocated to us from the common pool. If we are to continue the expansion of production as planned, this means more output from the same machines, the same floor space, the same managements, technicians, and operatives. It means fewer delays, regularity in flow both of orders and of deliveries, better balance at all stages. The correction of imperfections or maladjustments in all these details is to a large extent a question of re-allocation, and it is specifically with this field of action that this statement will deal.

"Re-allocation" may apply, on the one hand, to contracts or the particular work assigned to each production unit; or, on the other hand, to one or more of the elements of which production capacity is compounded—that is, floor space, machines, and labour. The re-allocation of contracts will be justified where a different run of jobs will permit more balanced utilisation of a firm's resources. With the help of the Supply Ministers, this question is being constantly watched, and in the sub-contract field especially, much readjustment and improvement can yet be effected. The new Regional and District Capacity Officers of the Regional Boards will be largely used for this purpose, and I ask all concerned in industry to make the greatest possible use of these facilities.

The re-allocation of production resources will be mainly a question of labour. It is a prime necessity, not only that every available person, and particularly skilled labour, should have a job, but that it should be the right job, and that the work should be done under the best conditions or the best available plant, so that the effort exerted may yield the highest possible results in useful production. The Government is not satisfied that these conditions are universally met at the present time, and wherever a factory comes to light in which labour is misapplied, or in which the resources in plant or in technical ability are too meagre to permit of the productivity that we must have, I propose to take corrective measures. The guiding principal must always be—How can we get the maximum amount of useful production from the resources that are at our disposal. The first attempt will always be to correct the weaknesses which exist and to see if the desired result can be obtained by the rearrangement of contracts or by an improvement of management. If this course is impracticable, the next alternative will be to devise groupings or affiliations which will bring about an enlargement of the unit of production and so make possible better balance of plant. I feel quite sure that there are still many undertakings which can be turned by means of this kind into valuable production units, although in their present condition they are not really suitable to continue on war production work.

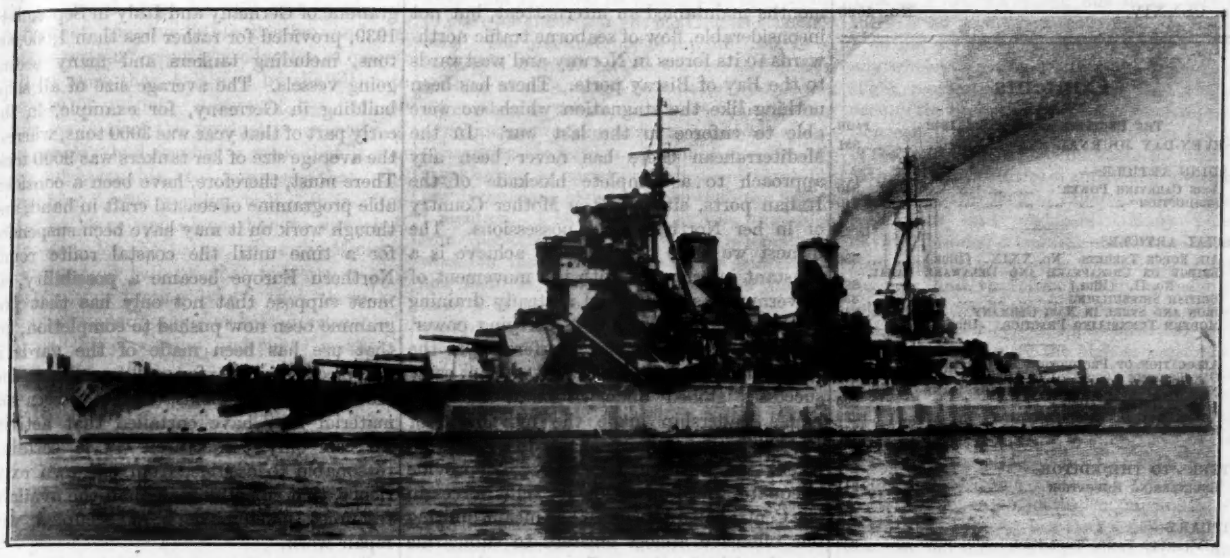
There are many cases where individuals and firms in their anxiety to assist in war production have secured contracts from other firms which are quite unsuited to their technique or equipment, and who are using skilled and other labour which would contribute far more to efficient war production if it could be put to employment in factories which are properly supplied in all respects except labour. In such cases, if no other remedies are applicable, I intend, acting on the advice of the Regional Boards, to prohibit the undertakings concerned from taking further orders for the kind of work in question. Their labour will then be transferred where it can be more usefully employed. This action will, of course, only be taken if alternative and better arrangements can be made to obtain equivalent output elsewhere. I am making use of the Regional Boards to look into each case, and it will be their job to try to find the best solution which will give the desired result with the minimum of disturbance. Any Orders prohibiting firms from taking on further business will be issued under the authority of the Minister of Production, and this authority will not be delegated to the regions.

Both in fairness to existing undertakings and to prevent a further dissipation of resources, it is clearly necessary to control the establishment of new undertakings which are not likely to be effective units of production. The President of the Board of Trade has therefore amended the Location of Industry (Restriction) Order in such a way that it is now necessary to obtain a licence for any manufacturing undertaking coming into existence or changing the nature of its activities, whatever its size. We are anxious that this new provision should be made widely known, as any undertakings starting work or changing their activities without such a licence will be liable to be closed up.

There is a second direction in which opportunities must be sought for the re-allocation of productive resources, and this is in the assignment of activities to those towns or districts which are at present heavily loaded. When the expansion or duplication of a branch of industry becomes necessary in time of war, there is a natural and often quite inevitable bias in favour of its location close by the parent unit, where highly trained staff, skilled supervision, and the long experience of management and labour will be best able to undertake the task of setting it successfully to work, and so certain towns tend to become every day more densely packed with industries. The same trends also result in the association of like with like, so that heavy industry develops near other heavy industry, and light industry near other light industry, with the result that the balance of employment between men and women presents greater difficulties in some regions than in others. All these factors, besides the necessary establishment of some classes of war factories in the less populated areas, have made it necessary to set afoot a widespread transfer of labour away from the less heavily burdened areas to those which can no longer supply from their local resources all the workpeople needed for essential production. This trend has, of course, many serious drawbacks. On the personal side, it involves inconvenience and hardship, and the additional strain on *morale* which may often result from working in strange surroundings. On the practical side it involves extra travel at a time when we are trying to reduce all travel to a minimum; there are difficulties of billeting; it is frequently necessary to embark on housing programmes or the building of hostels, which, in turn, further aggravates the labour situation; a concentration of industrial activity in particular towns imposes great pressure on the transport, electricity, gas, and water services, and here, too, expansion programmes involving more materials and labour are the result.

Since the building of new capacity is now the exception rather than the rule, it is no longer possible to correct the position solely by controlling the location of new plants. This is being carefully watched, but there will still be cases in which certain special classes of work have to be sent to the same congested towns that we should so much like to relieve, simply because the basic facilities already there are, to all intents and purposes, immovable. In the face of this there is only one possible course

H.M. BATTLESHIP OF THE "KING GEORGE V" CLASS



which will free the labour for such new essential load, and that is by removing to other regions undertakings which are not necessarily tied to the town in question. Sometimes the factories would be engaged on war production and sometimes on essential work for the civilian market.

This will, therefore, now be a definite policy. Departments are already studying such transfers in relation to particular industries, but I have further charged the Regional Boards with the task of suggesting undertakings which would be appropriate for transfer according to this plan. Arrangements have also been made to find places in the less heavily loaded districts to which firms can be transferred, and in which they will be able to carry on under less congested conditions and in less direct competition with more vital industry. When the transfer is decided upon, it will then be arranged for the firm's plant and key personnel to be transferred, but the bulk of their labour will be left behind to be redirected to other work near their homes.

Sixty Years Ago

THE VIENNA ELEVATED RAILWAY

IN our issue of October 27th, 1882, we find an extract from a recent issue of *The Wiener Herald* which revealed some of the trials and tribulations experienced by British engineers and financiers when seeking to promote the development of foreign countries. Fogerty and Co., of London, were interested in a scheme for providing Vienna with an elevated railway, but the Gemeinderath—that is, the City Council—procrastinated over the granting of the concession to such an extent that the English company threatened to withdraw entirely from the business. The Vienese newspaper did not spare the "Fathers of the City" from a castigation for their action. It expressed its admiration for the manner in which Mr. Fogerty had persevered with the scheme in face of everything that narrow-mindedness, short-sightedness, and ambiguity could devise to thwart its execution. Every stick that could be found was, so to speak, thrown between his legs, and all his goodwill and all his readiness to comply with the wishes of the Gemeinderath were met with systematic derision instead of proper acknowledgment. At last, when the Council was almost at its wits' end to devise new means of annoying Mr. Fogerty, it invented attempts at bribery in order to discredit him as much as possible. Instead of thanking Heaven that foreign capital and construction capacity was willing to carry out an undertaking which native resources left to themselves would be unable to execute for many years, the City Council, said *The Wiener Herald*, in its almost incredible ignorance had employed every means it could think of to render the undertaking impossible. The newspaper welcomed the news that the Austrian Government had decided to intervene in the matter, and, overriding the City Council, to grant Mr. Fogerty the desired concession. It would, it added, be greatly to be regretted if he decided to withdraw. "The English," it concluded, "not only bring us their good ideas, they also bring us their good money."

The New Battleships H.M.S. "Anson" and H.M.S. "Howe"

ON Wednesday, October 21st, it was officially announced by the Admiralty that two further battleships of the "King George V" class—H.M.S. "Anson" and H.M.S. "Howe"—are now at sea with the Fleet. The "Anson" was laid down in July, 1937, and was built and engined on the Tyne, her hull being entrusted to Swan, Hunter and Wigham Richardson, Ltd., and her machinery to the Wallsend Slipway and Engineering Company, Ltd. H.M.S. "Howe" was laid down at the Govan yard of the Fairfield Shipbuilding and Engineering Company, Ltd., on the Clyde, where she was built and engined. Each ship has the following principal particulars:—Displacement, 35,000 tons; length, 739ft. 8in.; beam, 103ft.; and mean draught, 27ft. 8in. The armament includes ten 14in. guns, sixteen 5·25in. guns, and four multiple pompoms, besides several smaller guns. The 14in. guns, it is stated, are of a new model, which has an effective range greater than that of the 15in. guns which were mounted in earlier ships. The design includes enhanced defence against air attack. Provision is made for the carrying of four aircraft on each ship. The propelling machinery comprises a quadruple-shaft arrangement of Parsons geared turbines, taking steam from Admiralty type three-drum oil-fired boilers. The total shaft horsepower for each ship is about 152,000, corresponding to a speed of something over 30 knots. The complement of officers and crew is 1500. H.M.S. "Howe" is commanded by Captain C. H. L. Woodhouse, R.N., who commanded the cruiser "Ajax" at the battle of the River Plate, and the "Anson" by Captain H. R. G. Kinahan, R.N. The "Howe" has been adopted by the City of Edinburgh and the "Anson" by the City of London.

Novel Dry Dock Construction

To expedite construction on some of the new large dry docks for the war programme of the United States Navy a method has been devised which dispenses with all cofferdam work and builds the dock "in the wet," each dock requiring about 250,000 cubic yards of concrete deposited by means of tremies. Dipper dredgers with large grab buckets excavated the site to a level 70ft. blow high water, the bottom being then levelled by dragging over it a heavy rolled steel joist suspended from tugs. After a bed of 2ft. of broken stone had been deposited and levelled, floating pile drivers drove about 7000 steel piles consisting of rolled steel H beams, 60ft. long. These were spaced 5ft. apart and were left with their tops at about 3ft. above the bottom of the excavated site. Floating cranes or derricks then lowered steel box forms on to the piles for the concrete floor, 14ft. thick. They were adjusted into position by divers and had light removable towers extending above water so that instrument men on shore could check the position and elevation. The forms extended across the full width of the dock, including the side walls, and the concrete was poured in transverse sections, 12ft. wide. Concrete was placed by tremies or pipes, 60ft. long and 12in. in diameter, each having a hopper at the top to receive the concrete. Eight tremies were mounted on a large barge, to which concrete was pumped from a mixing plant on shore. Placing the 12ft. by 14ft. rib of concrete, 158ft. long, was begun at one end and continued steadily to the further end. About 13ft. of each end was partitioned to form the base of the side walls, which were built by the same method. Both the floor and wall forms were of corrugated steel plating, braced by interior steel trusses, which were utilised as reinforcing steel in the walls, being supplemented by bars. The concrete mixing plant had a capacity of 250 cubic yards per hour.

THE ALASKAN HIGHWAY.—The early opening of the great road which will link the United States with its territory to the north-west of Canada was announced in Parliament recently, but before October 1st motor lorries had passed over it. It may be well to record again that it extends from Edmonton (Alberta), through Fort St. John and Fort Nelson (British Columbia), and White Horse (Yukon Territory), to Fairbanks (Alaska), a distance of some 1200 miles. The highway is spoken of in some quarters as the Alcan Highway (*i.e.*, Alaska-Canada).

The Engineer

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**** Will Subscribers please note that in all advices regarding changes of address it is necessary to have* **both old and new address,** *as our lists are kept alphabetically by towns. Advices of this nature should reach us by the first post Wednesday morning prior to the alteration.*

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AXIS CARRYING POWER

ONE of the marked differences between the war at sea in the present struggle and that of 1914–18 lies in the determined effort which has been made by the Axis Powers to make use of sea traffic along the Northern European coasts and in the Mediterranean. For both Germany and Italy all ocean-going trade is dead. It is probably safe to say that fewer than a score of vessels have reached German ports from the outside world since September, 1939, and that no Italian ship has got home at all. But whereas the Kaiser's Government abandoned all coastwise movement through the Bight of Heligoland after one or two half-hearted attempts at convoy had been squashed by the activity of our Harwich forces, the Nazi Government has for eighteen months maintained an intermittent, but not inconsiderable, flow of seaborne traffic northwards to its forces in Norway and westwards to the Bay of Biscay ports. There has been nothing like the stagnation which we were able to enforce in the last war. In the Mediterranean there has never been any approach to a complete blockade of the Italian ports, either in the Mother Country or in her North African possessions. The utmost we have been able to achieve is a constant interference with the movement of Government supplies and a steady draining of the enemy's resources in carrying power. The effectiveness of our interference in the Mediterranean has fluctuated. The early successes gained under Admiral Cunningham's leadership made the movement of Italian convoys most hazardous, but in recent months our inability to provide adequate air co-operation for light forces in the Central Mediterranean has meant limiting our offensive almost entirely to submarine attack. The northern offensive, on the other hand, has been carried out by light surface forces and by aircraft as well as by submarines.

An accurately balanced account of enemy losses in tonnage cannot yet be compiled, but in round figures it may be said that Germany and Italy started the war with approximately 8,000,000 tons gross register, and that the amount captured, sunk, or damaged up to July of this year was slightly in excess of 6,000,000 tons. These figures omit any damage due to operations by the Russian naval forces in the Baltic and in the Barents Sea, the approximate figure for which is believed to be 750,000 tons; neither does it include vessels which were laid up in Central and South American ports and are not available to the enemy. To get a completely accurate picture of the present position it would be necessary to know how much of the 6,000,000 tons "loss" is represented by ships only damaged and likely to return to service after repair. We know that in our own case several million tons of shipping which the enemy had officially reckoned as lost tons have in actual fact been repaired and restored to service. We must therefore make an allowance for a similar state of affairs among the enemy ships, while not losing sight of the fact that our mining policy in the shallow coastal waters through which the enemy ships have to pass may have caused many sinkings of which we have heard nothing. On a careful computation it is probably safe to suggest that the enemy carrying power at sea to-day is not more than half the pre-war tonnage. This does not take into consideration the Japanese merchant navy, since this plays no part in the European struggle and is a matter for entirely separate calculation. Replacement of the lost tonnage cannot be computed so closely even in round figures, for there are many factors of which we can have no knowledge. Seizure of shipping formerly owned by the countries that have been overrun has certainly been more helpful to the enemy than is generally realised. Germany's need of tonnage was not among the larger ocean-going craft, of which so many escaped capture and are now working with us. The German need was among small coastal craft, and these formed a large proportion of the tonnage captured. The mercantile building programme of Germany and Italy in September, 1939, provided for rather less than 1,000,000 tons, including tankers and many ocean-going vessels. The average size of all ships building in Germany, for example, in the early part of that year was 3000 tons, whereas the average size of her tankers was 9000 tons. There must, therefore, have been a considerable programme of coastal craft in hand, and though work on it may have been suspended for a time until the coastal route round Northern Europe became a possibility, we must suppose that not only has that programme been now pushed to completion, but that use has been made of the yards in occupied territory for a large expansion. How far the problems of man power and material may have curtailed that activity we can only conjecture. It is certainly reasonable to assume, from our own experience, that something like half the available resources must have been occupied with repair work.

Balancing all the factors it is not unduly optimistic to suggest that Axis carrying power, both in Northern and Southern European waters, has been more heavily reduced proportionately than has the world carrying power of the United Nations. Its local seaborne traffic continues and, given the existing conditions, we must expect it to continue, but it is carried on under great and increasing difficulties, and it is well that we should remember that it is not we alone who have anxieties on this score. Finally, from any study of the enemy's present position in regard to carrying power at sea there must arise in the mind of any thoughtful student the question: Where would Admiral Raeder to-day find the tonnage necessary for a full-scale seaborne invasion of Great Britain?

Production

IN the House of Commons on October 14th Mr. Lyttelton took advantage of a question asked by Mr. Arthur Greenwood to say something about the new measures proposed for spreading the demand for power, transport, housing, and, above all, labour more evenly by transferring the key personnel and plant of selected undertakings out of the congested areas, and for dealing with firms whose use of scarce resources is wasteful. Subsequently at a Press Conference the Minister of Production extended his answer in an announcement which we reprint on page 338.

Mr. Lyttelton, it is clear, recognises that the proposed reformation will not be popular either with factories or workpeople, and that it may even meet with actual opposition. But he insists that the changes are necessary and expresses confidence "that they will be borne with the same fortitude and understanding which have been shown by those who have suffered similarly through the concentration of civilian industry, and by all the men and women who have obeyed without complaint the call to change their place of employment or to serve in the Forces." This confidence will only be justified if all those concerned can be convinced, beyond a peradventure, that the changes are really essential and that unless they are made our

war effort will still be less than its attainable maximum. On that matter Mr. Lyttelton's Ministry is the only competent authority and it must be assumed that before taking the proposed steps he will satisfy himself fully that the inevitable friction and the almost certain temporary reduction of output will be more than balanced by the ultimate increase of output. Assurance has been so often given that the productive capacity of the country had reached a peak that it was not unreasonable to suppose that the "machine" was working well. It is often wiser to leave well alone than to disturb it by seeking for the better. But the Minister of Production believes that industry is still capable of a further effort, that there are certain "imperfections or maladjustments" that call for correction, and that "re-allocation"—yet another vague but perhaps useful term—will remove anomalies and lead to an even greater output than that already attained. That being so, we may share his confidence that both management and labour will co-operate with him in his endeavours.

One wonders sometimes what is happening to the colossal output of this country alone. Germany is using up her production as fast as she makes it. We ourselves are using only a small fraction of what we are making. In aeroplanes, for example, our output must far exceed the actual losses. Presumably, the greater part of the production of war materials of all kinds goes into "cold storage" in readiness for the great offensive, and a great deal goes overseas, where also, save in Russia, most of it is being reserved for the future. It is not the least likely that the public will ever be told how the vast output is being allocated, but it will not deny itself the pleasure of believing that, both at home and abroad, we are building up stocks far faster than they are being consumed, and that we are in sight of an accumulation of reserves of such a magnitude that a super-abundance will exist when the great day dawns.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

ENGINEERING EDUCATION

Sir,—I have read Mr. Russell's letter, published in your issue of October 16th, and would ask to have an opportunity of replying. I note that Mr. Russell's letter in your issue of September 11th was intended to draw attention to the fact that in my original letter, published in your issue of August 21st, I do not make any mention of the cost of the engineering training I advocate. He then set out an estimate to which must be added the cost of elementary and preparatory education, which additions, on Mr. Russell's basis, would make the total cost of the education of the order of £4000. He then goes on to complain that such an education is not justified by the salary an engineer can expect to obtain. I could but assume that such an assertion would create an impression that my proposals are not practicable. I therefore hastened to set out the estimate on which I based my proposals, showing that the education I advocated can be obtained at a cost of £72 10s. per annum. Mr. Russell now suggests that my total was nearly equal to his, and makes some very misleading deductions, further stressing the impossibility of putting my proposals into practice without a complete revision of salaries.

I do not advocate that engineers should receive the salaries of £500, £600, and £700 which I mention. Mr. Russell may not be aware, but many of your readers undoubtedly will be, that it is a principle of sound government that it should be possible for any person to place his children in the next higher economic level. The practicability of my proposals must be judged, therefore, not on whether an engineer, working as such, would be capable of educating his children to the required status, but whether a technician, working as such, would be capable of carrying the burden. I cannot visualise any organisation of society which could equitably pay technicians higher salaries than the figures I mention. I have arrived at this conclusion from personal experience, from attempts to work out theoretical proposals for establishing new factories, and from a perusal of Pareto's Law, a table based on whose work has been worked out by W. E. Bruges, A.M. Inst. C.E. (published by Robert Grant and Son, Ltd., 126, Princes Street, Edinburgh, under the title of "The Curve of Incomes of Vilfredo Pareto").

I think that Mr. Russell is rather rash in suggesting that for £100 one cannot obtain a first-class education, and that it is doubtful if even a second-class education would be available. The question virtually rests on whether the education provided at schools of the type of Eton, Harrow, and Marlborough is better than that provided at schools of the standing of Edinburgh Academy or St. Paul's, London. That the former schools provide certain advantages in respect of personal contacts, and thus the entry to certain specific circles, there seems to be no doubt, but whether they give a better education is very doubtful. I am certain that the latter schools, backed up by a suitable domestic environment, are much more appropriate to the son of a technician aspiring to be an engineer. For these latter schools, attendance as a day boy is amply covered by £100 for fees and expenses.

It is unfortunate that I failed to state in my letter (October 2nd) that I did not expect the person intending, in the marginal instance, to educate his children to be engineers, to have his first child until his income attained the level of £500, the second when his income was £600, and the third when his income was £700. That is, of course, if the unusual course of educating all three children to the same level was to be adopted.

If the above points were clear, the picture as presented by Mr. Russell's estimate is completely incorrect. My estimates show the following :—

Income per annum.		Dependents.		Amount available per week after meeting income tax and educational expenses.
£				£ s.
500	...	Wife and one child	...	6 0
600	...	Wife and two children	...	6 10
700	...	Wife and three children	...	7 0

I appreciate that the above amounts are not luxurious and are out of proportion to the education being received by the children, but it is possible to live satisfactorily on these sums, provided the parents are determined to raise the economic level of their children, and no danger to health or mentality is involved thereby.

I would support Mr. Russell's contention that engineers must receive adequate salaries. We would, however, only make ourselves ridiculous if we advocate the impossible of providing technicians with salaries the industry cannot find. I think if Mr. Russell, or any of your readers who are interested, investigate, they will find that in most engineering firms there are some ten or twelve people for each factory or section of a factory employing, say, 1000 to 1200 persons, who receive over £1000 per annum, their salaries being quite comparable with the earnings of the other professions. Certain of these, such as the secretary, accountant, cashier, and cost accountant, are inevitably not engineers, but the remainder should definitely be engineers, as defined by me. Unfortunately, only too often the persons in receipt of the higher salaries are not engineers. This is, I am convinced, due to the fact that there is no recognised status for an engineer. I do not therefore think it necessary to have any wholesale revision of salaries, but merely a slight reorientation to ensure that engineers occupy the necessary positions. Such reorientation can, I believe, only be done on the basis of recognised education and status for engineers. Many of the difficulties of apparently low salaries are due to this lack of differentiation between technicians and engineers. Many persons, having obtained a training somewhere between that which I consider is the minimum for an engineer and that required by a technician, complain that they are unable to obtain a satisfactory salary. I appreciate that all like to call themselves by the highest possible title, but I would stress that this results in a lack of standing for the whole profession. How can technicians expect to have their status recognised until they, in turn, are prepared to recognise the status of engineers ? I believe that it is quite practicable under modern conditions for a technician to justify an income of £500 at the age of thirty, but that a higher salary is not justified unless the productivity of labour can be much increased.

To satisfy Mr. Russell, I would say that I am married and have a son, and my interest in actual cost of education arose from the necessity of forming an estimate of the provisions necessary for his education. Should my son decide to be the eleventh in direct succession to serve in the engineering profession, I shall be pleased to discuss with Mr. Russell the results of my efforts some twenty-five years from now.

N. V. Pestereff.

Edinburgh, 10, October 19th.

Replanning London

In a Journal note in our last issue we referred to the opening of an exhibition at Burlington House dealing with the planning of London for rebuilding after the war. That exhibition, which is one that all engineers can be recommended to see, consists of a number of maps, plans, and architectural drawings prepared by members of the Royal Academy Planning Committee, of which Sir Edwin Lutyens is Chairman and Sir Charles Bressey Vice-Chairman. That Committee, we understand, will shortly issue an interim report upon its proceedings.

As was to be expected in view of the appointments in the Committee held by Sir Edwin Lutyens and Sir Charles Bressey, the plans exhibited are based upon those suggested in the Highway Development Survey, 1937 (Greater London), better known as the Bressey Report. But there are considerable differences. The main object of that Report was to provide plans for the development of London's highways to meet the needs of growing modern road transport. Sir Edwin Lutyens acted as an architectural consultant in its preparation. In the present exhibition greater prominence is given to the architectural implications of replanning. Moreover, since the Bressey Report was published, the bombing of London and the destruction of large areas by fire have introduced an entirely new factor which permits greater freedom to indulge in alterations, the cost of which, otherwise, would have been prohibitive. Thus, many of the proposals now made found no place in the Bressey Report.

The grand skeleton of the plan revealed by the exhibition consists of a ring road around inner London and the removal from within that ring of all above-ground railways. The main line stations, some of which are wholly abolished, are all removed to, or already sited upon, the new road. Beginning at the Tower Bridge, the road follows southward along the line of Tower Bridge Road as far as its junction with New

Kent Road. It then swings south-westward and westward to Vauxhall Bridge. This is a scheme not provided for in the Bressey plan. London Bridge Station is moved from its present site to Bricklayers' Arms, thus bringing it on to the ring road, and Waterloo Station is similarly shifted to Nine Elms, just on the eastern approach to Vauxhall Bridge. The remaining Southern Railway stations in the central area, including Charing Cross, Cannon Street, Holborn Viaduct, &c., are all abolished. From Vauxhall Bridge, according to the plans, the new ring roads run to Victoria Station, Hyde Park Corner and Marble Arch, and thence directly to Marylebone Station, which, though enlarged, occupies substantially its present position. A branch from the ring road runs out from Marylebone Station to the neighbourhood of Paddington. The Euston Road forms the continuation of the ring, passing a new Euston, which will provide all those services at present given by Euston, King's Cross, and St. Pancras. The ring continues by way of Pentonville Road and City Road, and cuts across to a new Liverpool Street Station at Bishopsgate, and a new Fenchurch Street Station near the meeting of Whitechapel High Street and Commercial Road. Thence it swings back to the Tower. With the exceptions of the portions between Marble Arch and Marylebone and between Liverpool Street and Tower Bridge, the whole of this northern circuit is based upon the proposals in the Bressey Report. Besides being linked by the new ring road, it is proposed that all the main line stations should be connected by a new underground railway.

The removal of above-ground railways from the central area frees the hands of architects for a number of detailed, but interlinked improvements of that area. Alternative proposals are made in certain cases, some of them dependent, it is of interest to note, on whether or not the project for a Thames barrage below London is brought into effect. The suggested improvement of major interest to engineers is the renewal of the proposal for a road bridge at Charing Cross. The removal of the railway eases the problem, and the plans show a high-level bridge passing over embankments on both sides of the river. On the south the approach would rise to the bridge from a roundabout shared with the Waterloo Bridge approach, whilst on the north there would be two approaches, one from Trafalgar Square and the other from a roundabout in the Strand north-east of the present site of Charing Cross Station. The Charing Cross Road, it may be noted, would pass under an extension eastwards of Piccadilly, and Piccadilly Circus, belying its name, would become rectangular, permitting the Haymarket to run up into its south-eastern corner.

Within and without the area bounded by the ring road there are many suggestions for improvement—far too many for all to be mentioned here. There are proposals for the area around St. Paul's Cathedral, which would open up vistas of that building from the west and north and from the river. A suggestion is made for a processional way from Victoria Station to the Palace. Plans have been drawn out for the improvement not only of the highways around, but for the appearance of the Westminster district. If the proposals are carried out, vistas of the British Museum will be opened up and a great National Theatre will arise opposite the Victoria and Albert Museum. All such suggestions, though architectural in character, will be of interest to engineers, if not in their professional, at least in their private capacities.

The aim of the Royal Academy Planning Committee is not, we believe, to plan a new London, but to show to the best advantage the London that already exists, combining in one plan changes necessary to accommodate the great flow of modern traffic with architectural improvements. The comment may be hazarded that though many of the detailed proposals will surely form the basis for future rebuilding, experience suggests that the more revolutionary plans for the removal of railways from the central area will not be accepted without extended discussion, desirable though the project undoubtedly is on architectural grounds.

Iron and Steel in Nazi Germany

(By a Special Correspondent)

THE supply of iron and steel is now developing into a major economic problem in Nazi Germany. The present state of affairs fully justifies the criticism of those who have been doubtful about the usefulness, even from a Nazi point of view, of the technical policy pursued by the German Government since 1936.

One apparent weakness of the German iron and steel industry when the Nazis came to power was its dependency on foreign ores. In 1936, when the German industry had largely recovered from the 1930–32 slump, the Reich produced 19·2 million tons of steel, while only 7·6 million tons of ore, with an average content of less than 30 per cent. of iron, were worked in Germany. About half the imported ores came from Sweden, the remainder from the Lorraine, Spain, and French North Africa. In the second part of that year the Reich authorities issued a Four Years' Plan, which aimed at making Germany independent, as far as technically possible, from the importation of raw materials. Hermann Goering became Reich Commissioner for the promotion of self-sufficiency, and he advanced a suggestion for increasing the output of local iron ores. The new mining activities were to be pursued mainly in the Salzgitter district, at the foot of the Harz Mountains in Central Germany, where there exists, according to official estimates, a reserve of at least 1000 million tons, and probably as much as 2000 million tons, of low-grade ores. The original plan was to increase the annual output in the Salzgitter district to 20 million tons, with 6 million tons of iron content, and the annual output in other districts, particularly South-Western Germany, to 25 million tons, with 5·5 million tons of iron content. The Plan was amended after the incorporation of Austria, and the new target for the whole of Greater Germany was then stated to be 50 million tons of ore, with an iron content of 12·7 million tons, per year. It was also hoped to increase the production of iron and steel so that the suggested iron ore output would represent about 50 per cent. of Germany's ultimate requirements.

This plan was opposed by most industrialists on sound technical and financial grounds. August Thyssen was particularly sceptical, and left Germany after the outbreak of war. Not only are the Salzgitter ores comparatively poor as far as iron content is concerned, but they contain between 20 and 30 per cent. of silicon, and were therefore formerly considered to be quite unworkable. A liquid slag can now be produced from such ores, according to the Paschke-Peetz method, by the admixture of lime, and the large percentage of sulphur which thereby originates is later removed by a soda treatment. However, the whole process is extremely costly, and its large-scale application was never justifiable from a business point of view; even the military usefulness of this expedient was more than doubtful from the very beginning. The costliness of the procedure means, among other things, that more labour, more coke, and more power are needed for the extraction of a given quantity of Salzgitter ores than, for instance, of Swedish ores. Moreover, large initial investments would be necessary, and it would in any case take many years before the planned "semi-self-sufficiency" would be attained. When the war actually started only about 25 per cent. of the German requirements (in terms of iron content) were supplied by local mines. Another important point is that for the working of the Salzgitter ores, the admixture of other high-grade ores is required, so that even if a 50 per cent. "autarchy" should ever be statistically attained, the German ores would still be useless without a constant influx of iron ore from abroad.

In the summer of 1937, after several months of fruitless discussions with the industrialists, Hermann Goering decided to act. On July 27th a special company known as the Hermann Goering Works was founded for the working of the Salzgitter ores. The industrialists who possessed property rights in this district were expropriated, but compensated with free non-voting shares in the new company. But the Hermann Goering Works would not content themselves with mining activities. They immediately started the construction in the Salzgitter district of huge furnaces with an annual output capacity of at least 4 million tons of pig iron. The Salzgitter district is situated about 150 miles from the nearest coal-mining centre, in the Ruhr. The extraction of its ores has therefore been made still more expensive by high railway charges. Admittedly, the transport of the Salzgitter ores themselves has thus been saved, but while Swedish ores can in normal times be shipped to the Ruhr furnaces, *viâ* the Rhine, no similar possibilities exist for cheap river transport of Swedish ores to the Salzgitter district.

It has, indeed, been admitted in numerous recent company reports that the production of iron and steel is no longer a profitable business in Germany, and, according to the German technical and financial Press, prospects for an early recovery do not exist. The excessive production costs cannot be compensated by higher iron and steel prices, as these have been fixed by the German Price Stop Act on the 1936 level. The prices for manufactured goods, on the other hand, are being fixed either on the cost-plus principle or according to a special price schedule for armament production, which leaves a fair profit margin to manufacturers. There has therefore been a marked tendency for iron and steel producers to acquire property rights or shares in manufacturing establishments. Vertical trusts have, as a rule, overcompensated the losses of their iron and steel production by their highly profitable other businesses. Dr. Funk, Reich Minister for Economic Affairs, has occasionally expressed his disapproval of such vertical merging, which he considers unfair towards the mere manufacturers of secondary goods. However, the semi-official Hermann Goering Works have extended their sphere of influence even farther than any private firm.

The Hermann Goering Works has grown from comparatively modest beginnings into a position unequalled by any other industrial trust in modern European history. With every new territorial gain on the part of Germany, it has acquired new interests in various industrial fields. It is now, among other things, the sole owner of the Skoda Works and the Bruenner Waffenwerke in Czechoslovakia; it also owns the Austrian Alpine Montan Works, various Silesian collieries, ore mines in Lorraine, and it controls most of the Danubian shipping; it trades in petroleum, and it is one of the leading Continental producers of office equipment. Furthermore, after the occupation

of large parts of Soviet Russia, the works "acquired" the right to administer the whole of Russia's mining and heavy industries. Early in 1941, as many as 600,000 workers were employed in works belonging to the Hermann Goering Trust, not including those working in factories which are only partly owned by this giant industrial enterprise. Some of its activities have proved so remunerative that, in spite of the unprofitable Salzgitter business, the company made, in July last year, an offer to purchase back the shares which had been given to the former Salzgitter proprietors.

There was a unique chance for Germany to reconsider her iron ore policy after the conquest of France and the Low Countries in the summer of 1940. The acquisition of the minette ore mines of Lorraine, in addition to the smaller, but valuable Luxembourg mines, made self-sufficiency in iron ore a reasonable proposition for the first time since the inauguration of the Four Years' Plan. Moreover, Germany incorporated both Alsace-Lorraine and Luxembourg into Germany proper and the Saar industrialist Hermann Roechling was entrusted with the economic administration of Lorraine. Minette ores are not nearly so rich in iron as Swedish ores, but they contain less silicon and more calcium than the Salzgitter ores, and are therefore much more suitable for industrial exploitation. However, it soon turned out that the German Government did not intend to make full use of the Lorraine mines. Exaggerated statements were made in the German Press as to the destruction of Lorraine mines and transport facilities during the summer campaign of 1940. More recently, the *Frankfurter Zeitung* has stated that the Lorraine ores do not play a decisive part in the German industrial make-up. Indeed, the president of the Acières de Longwy said eighteen months after the invasion of France that he did not know of any plans for the future of the Lorraine iron industry. It would certainly have been necessary to do some additional engineering work in German furnaces if it had been decided to use a large proportion of minette ores; but such constructions would have been more worth while than all the Salzgitter activities. Besides, it would have been possible for the Germans to use minette ores in the French blast-furnaces which they might have fostered in their own interest. The French works are actually much better situated with regard to transport than the Salzgitter district, and it should be remembered that in 1940 and 1941 the Nazis made an attempt to reinstate many of France's industrial establishments, particularly chemical and engineering works. It was only in 1942 that this policy was revised, largely out of political and strategical considerations. However, even in 1940 and 1941, the Nazis cut down the ore and coal supply of the French furnaces, and refused to release French coal miners from the prisoner of war camps. Even in Belgium, where the local coal supply is much more plentiful, blast-furnaces have been cut down to 40 per cent. of their pre-invasion output. The only explanation why the Germans have not made a fuller use of the Lorraine windfall is that the vested interests of the Hermann Goering Works in the exploitation of the Salzgitter ores were a powerful barrier against a more reasonable economic policy.

Germany, including Austria and Sudetenland, produced the equivalent of an annual output of 25·3 million tons of steel immediately before the outbreak of war, and the output was apparently still on the increase up to the summer of 1940, new plant having come into operation. Later, however, according to all the major company reports, German steel production could only be just maintained at the mid-1940 level. Of the non-German countries inside the Axis realm, only Italy seems to have increased her steel production to a certain extent, mainly by the large-scale use of electric furnaces; but this method has admittedly proved extremely costly, and the total gains of the Italian industry are certainly on a smaller scale than the losses sustained in France and Belgium. The supply of Swedish ores to the extent at present needed by the German industry is probably not a major difficulty, though it is doubtful whether a large-scale extension of these imports, in order to replace German ores, would now be feasible. The shipping situation has never been good and was strained still further when the Germans were forced to introduce a Baltic convoy system as a precaution against Russian submarines. The transport of ores, after the severance of the Narvik and Northern Sea route, is only possible during the summer months, and in the last two years the time available was further shortened by the prolonged cold weather. It has been reported that the Germans and Swedes are busily engaged upon the construction of new harbour facilities in Lulea, in order to increase the capacity of that port to cope with the ore shipments.

Meanwhile, the supply of coal, which was formerly considered to be comparatively secure, has developed into a main bottleneck of the German industry. The output per man-shift has been on the decrease since 1938, and in spite of the employment of very large numbers of foreign workers (the German Press speaks of hundreds of thousands), in spite also of a vigorous fight against absenteeism and slackness, and in spite of a thorough administrative reorganisation of the industry, the total output has not been raised in Germany, whilst it has been severely cut in some of the occupied countries. Even the much-advertised Iron Miner engine, which combines various processes in the working and loading of coal, has not been of much avail in the Ruhr district.

Germany's misadventure in Russia has been the turning point in the development of her supply situation. It has now become increasingly difficult to overcome the raw material shortages by the simple expedient of civilian restrictions. Germany's steel requirements for the replacement of war material and for the fortifications on the Atlantic Coast must be enormous, and the types of aircraft which are now produced in Germany also require a comparatively large proportion of steel. On the other hand, it has not been found possible or expedient to restart work in the coal and iron ore mines of occupied Russia on any appreciable scale, and the Russian branch of the Hermann Goering Works was almost completely idle at least until a very short while ago. It is not even pos ible, in view of the transport difficulties, to send any large quantities of iron scrap from the battle fronts to the German industrial centres.

The German manufacturers have been exhorted time and again during these last few months not to concentrate too much on the durability and outward appearance of their produce. The production is being concentrated in as few factories as possible and the number of types has been greatly reduced. Just a few examples have been taken at random from the German Press. There are now manufactured in Germany only six patterns of pocket knives, six varieties of scythes, two varieties of ploughs and of threshing machines, one type of barbed wire for non-military use, one type of hair-cutting machines, &c. Numerous kinds of goods must not be produced at all.

In June this year a new compulsory organisation was formed with large powers for directing the production and distribution of iron and steel. This "Reich Association for Iron," under the presidency of Hermann Roechling, is, in fact, a huge vertical cartel, which combines all productive, trading, and research companies of the iron industry, including both rolling mills and ore-mining establishments and which tries to carry rationalisation still further than before. There were formerly many bureaucratic institutions for the direction of the iron trade, often with overlapping authorities which were in many cases under the control of civil servants rather than of industrialists, and it is now hoped, with the help of the new organisation, to avoid unnecessary red tape.

Roechling, in a recent address to iron industrialists, made a special plea for promoting light constructions in the German engineering industry in order to economise material. The Reich Association will endeavour to improve metallurgical methods and to put particularly higher tensile and harder steels at the manufacturers' disposal. It is hoped that loads can in many cases be doubled by such means, and that the manufacturers will then be able to carry on with correspondingly smaller quantities of steel. This new technique calls, according to Roechling, for a "revolutionary change" in the whole outlook of German engineers.

The most striking recent development, however, has been the giant scrap campaign which was carried through under the auspices of the Reich Minister for Economic Affairs between July and September this year. There have been scrap collections in Germany before, but none on a comparable scale. All industrial establishments and all large and medium-sized farms were required to give up all their old iron, their unprocessed iron and steel material of unusual types and sizes, any semi-finished iron and steel products, and castings from cancelled orders. Furthermore, all spare parts and machinery which are not needed at present owing to the numerous changes of types were requisitioned, and under certain conditions plants were shut down. No considerations of post-war economy were allowed to interfere with the campaign.

The collection of old iron may have been fairly successful, as it is quite probable that many an industrialist or farmer had kept larger stocks of iron than he was supposed to do; but the really significant aspect of the campaign is the fact that, according to German Press reports, several million tons of semi-finished products were collected, and that huge quantities of brand-new machinery were to be seen in the scrap collection centres. The delivery was voluntary in name, but the action was "supported" by police, Wehrmacht, and S.S. authorities, as well as by special inspectors of the Ministry. As a rule, the industrialists and farmers received only the scrap price, though extra grants were given on special application for the sacrifice of manufactured articles. The reasons for this large-scale scrapping of German industrial installations have been fairly frankly stated in German newspapers. The most vital consideration is that about half the amount of coke is saved by the use of scrap instead of ores. Secondly, this saving of coke, combined with a reduction of ore transport, results in an appreciable transport economy, in spite of the need to transport the scrap to the furnaces. The collection was terminated on October 1st because after that date the

German railways are largely used for the transport of potatoes and root crops. The whole campaign illustrates the growing economic difficulties which are largely of the Nazis' own making, but it also shows the vigour and energy with which they try to find a way out of all their bottlenecks.

A few words should be added about the supply position with regard to steel alloys and to manganese. As to the latter, the Germans were able to replenish their stocks to a certain extent by imports from Russia up to June, 1941. Unfortunately, they have now succeeded in capturing an important Russian manganese ore-mining district, and they will certainly do their utmost to reinstate mining before their shortage grows really severe. The stocks of alloy metals in Germany must have been considerable at the outbreak of war, and certain additional quantities may have been transported from the Far East until Russia entered the war. Much research has been recently done in Germany on the improvement of steel alloys. Furthermore, while only small quantities of chromium, molybdenum, and cobalt are mined in Germany or her dependencies, the Germans are now able to make full use of the Finnish nickel ores. The construction of the Mond Nickel Company in the Petsamo district was finished shortly before the outbreak of the first Russo-Finnish War, and while the smelting plants may have been greatly damaged, Germany has additional facilities at her disposal on her own territory as well as in Norway. In 1943 Germany will also receive 90,000 tons of chromium from Turkey. Hence, in spite of various more optimistic predictions in this country, there is no conclusive evidence that the production of high-grade steel will ever be made impossible in Germany through the lack of alloys.

Modern Tunnelling Practice

By ROLT HAMMOND, A.C.G.I., Assoc. M. Inst. C.E.

IN his last article the author dealt mainly with methods of excavating tunnels of large cross section, and here he will try to describe some problems of lining large tunnels, and draw attention to important features, particularly those concerned with safety.

Fig. 1 depicts the lining of a double-track railway tunnel with brick invert and arch. The bricks may be good-quality engineering bricks, or they may be made on site with fine crusher dust and cement. Special machines for this purpose are made by Herbert Alexander and Co., Ltd., of Leeds. Their "Kingfisher" model is particularly suitable for this class of work. Another machine is known as the "Hercules" press. They are both fitted with rotary tables, and have high output rates. Used in conjunction with a good batch-mixing plant, they can yield excellent results, both in quality and quantity.

The first operation in lining the tunnel is the setting of what are known as the "ground moulds" after the full section of the tunnel has been excavated and timbered. The segments H and L are accurately plumbed and squared at the leading end of the running length, and joined together transversely by the cross-piece K. Great care should be taken in the brickwork of the invert, for here is a potential source of weakness unless the work is carefully supervised in the initial stages.

In order to simplify the drawing, the lower sill and uprights, and the props in way of the arch, have been shown dotted. When the brick lining at the sides has reached skew-back level, the steel ribs Q and R are set up on a framework composed of the props E and the footblocks and wedges F and G; cross-pieces D provide lateral stability. The ribs Q are known as "shroud ribs," and are set so that the laggins are at the correct level to give the section of arch required. The intermediate ribs R are set about 3in. lower than the shroud ribs, and the laggins are paged up to the same level as those on the shroud ribs by means of wedges, or "pages" as they are termed.

The brick arch is then turned on the laggins in the manner shown, the bricks being stacked on platforms laid between the ribs. There should be room for a pair of bricklayers to work on each side, with two labourers supplying them with bricks and mortar, and helping with striking the bars.

The bars A are struck by knocking the props B to one side, a short plank being placed at each end of the arch to support the bar, which is then slid or "railroaded" into the completed portion of the tunnel. As the arch is being turned, it is a wise precaution to provide "bricking-in pieces" M, which may be small timbers or decauville rails. They act as temporary supports for the poling boards in front of the leading end of the arch, and ensure that the ground is supported adequately before beginning the next length.

The process of "keying in" the arch is shown in Fig. 2. First the "groove laggins" B are placed in position, and these serve as supports for the transverse segmental laggins A. Each of these is about 2ft. long, and is shaped to the curve of the intrados of the arch. The bricklayer works his way through the arch in a longitudinal direction, finishing at the leading end with a toothing.

Great care should be taken in marking off the courses of the brick lining, in order to ensure that the mortar joints are of the correct thickness. The bricks should therefore be made of such a dimension that an even number of courses can be worked, with due allowance for the joints. In laying the bricks, usual precautions should be taken to see that the brickwork is bonded in both directions. The whole operation of bricking an arch of this kind is quite simple, but care in workmanship is all important.

In the example shown, the bars supporting the poling boards have been set at such a height that allowance is made for dry stone packing between the boards and the extrados of the arch. No drainage system has been indicated, since this will depend to a large extent upon the nature of the strata and upon local conditions. Suffice it to say, that the main object of any drainage system should be to ensure that water pressure does not build up behind the lining or form local pockets. The author is convinced from his own experience that a well-executed brick lining still holds an important place in all tunnelling works.

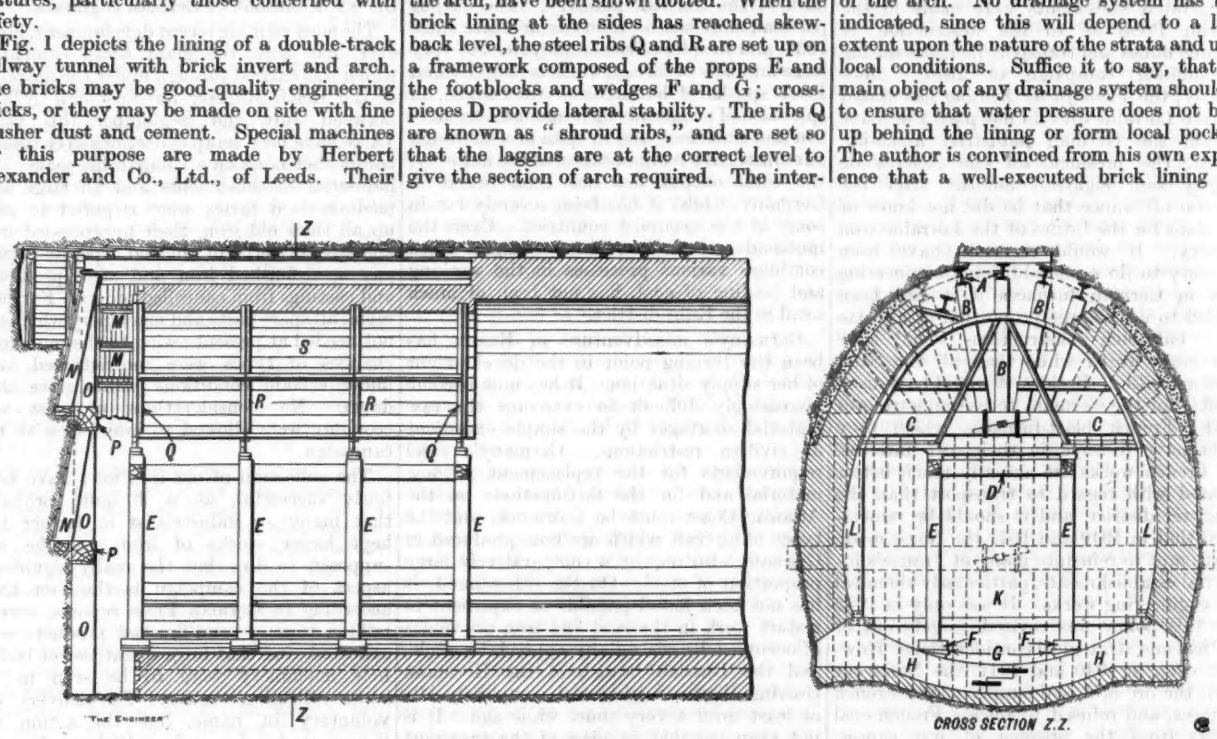


FIG. 1—LINING DOUBLE-TRACK RAILWAY TUNNEL

Now let us consider the excavation of a tunnel of large cross section in hard rock, which does not require any support. The diagrams in Fig. 3 show a sound method of procedure, in which use is made of a winch and scraper equipment. Here the "heading and bench" method is employed. The first operation is shown by cross section W W. The three bottom headings are first driven for the full length of the tunnel, which can then be divided up into a number of "break-ups."

The top heading is of large dimensions, and the shot holes are drilled by means of

column drills set up on the pillars B. The top sketches show the location of the shot holes, the numbers indicating the order of firing. The holes marked 0 are instantaneous, those marked 1 and 2 exploding at one-second intervals. The centre or "cut" holes slope inwards so as to intersect and form a wedge, which is blown out before the "easers" 1 and the "trimmers" 2 come into action. In order to simplify the drilling of the cut holes, the column is provided with a cross arm on which the machine can be mounted. This machine should be operated by the leading miner, who will also be responsible for getting the best possible results from the explosives used.

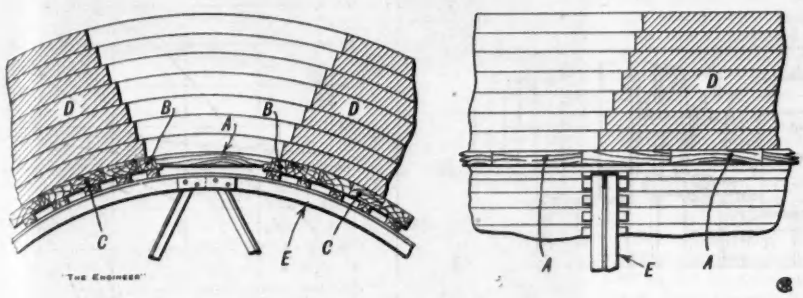


FIG. 2—"KEYING IN" THE ARCH

In the lower diagrams the lay-out of the scraping equipment is shown. The double-drum winch C is mounted on a pair of heavy timber beams D, rails E being spiked to the latter. The winch is air-operated, and can be clamped in any desired position on the beams. Small concrete foundations G should be provided for the ends of the beams, and for the turntable F, upon which the winch is turned round to face in the appropriate direction.

When shots are fired in the heading or bench, the winch is moved back on to the turntable, and is protected by the dry stone walls L, which are also built at the sides of the access shaft K. A sheave N is fixed in any desired position, and the scraper M is operated by the ropes P and Q, which are connected to the winches and pull the scraper backwards and forwards. Stop logs O should be provided at the outlet of the hopper, where the *débris* is discharged into the skip J.

When the full arch section has been excavated and mucked out, excavation for the side walls can then proceed. Following this, the side walls can then be built, the arching following in convenient lengths. The lay-out shown is simple and can be relied upon to give excellent results. It will be noticed that the centre heading is of larger dimensions than the side headings. The reason for this is that frequent turnouts must be provided for, so that the skips may be conveniently shunted. Cross headings, connecting centre and side headings should be provided at all break-ups.

In his last article the author stressed, among other things, the important influence exerted by careful attention to safety in promoting speed and efficiency in tunnelling operations. If any construction work should have a reputation for accidents, the news spreads like wildfire, and the psychological effect on workmen may well retard progress to an alarming degree. Careful attention to ladderways and to the protection of access to workings will be well repaid, for many accidents are due to rickety ladders and inadequate support of temporary shafts and headings. A great deal of this is due to the carelessness of the men themselves, the overriding desire to earn large bonus payments making them callous of their own safety and indifferent to the safety of others. This attitude of mind can only be changed by strict discipline and continual attention on the part of foremen and charge hands to a duty frequently neglected.

It is unwise, for example, to allow shafts to be used for men and materials. They should always be separate, and ladders and platforms for the man shaft arranged as shown in the sketch (Fig. 3). If a tall vertical ladder is provided for the full height of the shaft, this may well be the cause of a bad accident. It is obvious that in the case shown in the sketch the man can only fall through the distance between the platforms. Another important point is that a good handhold should be provided at the top of every ladder. This feature is also brought out in the sketch.

Accidents on this type of work are to be strongly deprecated, because they may result in the loss of the services of skilled and semi-skilled men for a considerable period. Labour for heavy tunnelling operations is by no means easy to obtain, for many of the processes need men who have long experience and skilled appreciation of the many difficulties bound to arise. The exercise of skill and initiative in every process should be encouraged, and specialisation should be adopted as a general principle.

The handling of explosives calls for the most sustained vigilance, from the powder monkey to the shot firer. In the author's opinion, safety fuses should always be capped in a central capping house, for even to-day one may see old hands crimping detonators with their teeth. This is a most dangerous habit, likely to lead to very bad accidents. The capping house should be kept very clean and well ventilated, and the fuse cutter inspected at regular intervals and kept in perfect working trim. Capped fuse should always be carried to the work in a felt-lined metal container. A piece of string should be tied to each fuse and should be employed for tying the fuse to the cartridge, instead of lacing the fuse to the cartridge.

The author cannot emphasise too strongly that safety fuse should never be used for a large round of shots; only four or five should be used at a time, and if fuses are cut to give rotation, then the maximum cut should not exceed 6in. from a 7ft. fuse. Great care should be taken to count the shots, and misfires should be immediately reported. Some engineers advocate drilling a new hole alongside the misfire and then charging and firing it, but the author would prefer to recharge the missed hole with another primer and then fire the primer. There is always the possibility that the hole drilled alongside the misfire will not be parallel, and the drill may touch off the unexploded charge, with dire results.

Electric delay action caps are now used so extensively on tunnel works, and have given such excellent results, that they should always be employed for firing a number of charges; great care should be taken to ensure that any possibility of stray electric currents is eliminated. Every cable, wire, or pipe in the vicinity should be earthed, and all wires should be in a shunted circuit until the firing switch is closed. The various forms of connecting the caps have been described in a previous article by the author. During an electric storm no charges should be fired in shafts, for the shaft steel may act as a conductor for the lightning to the working place.

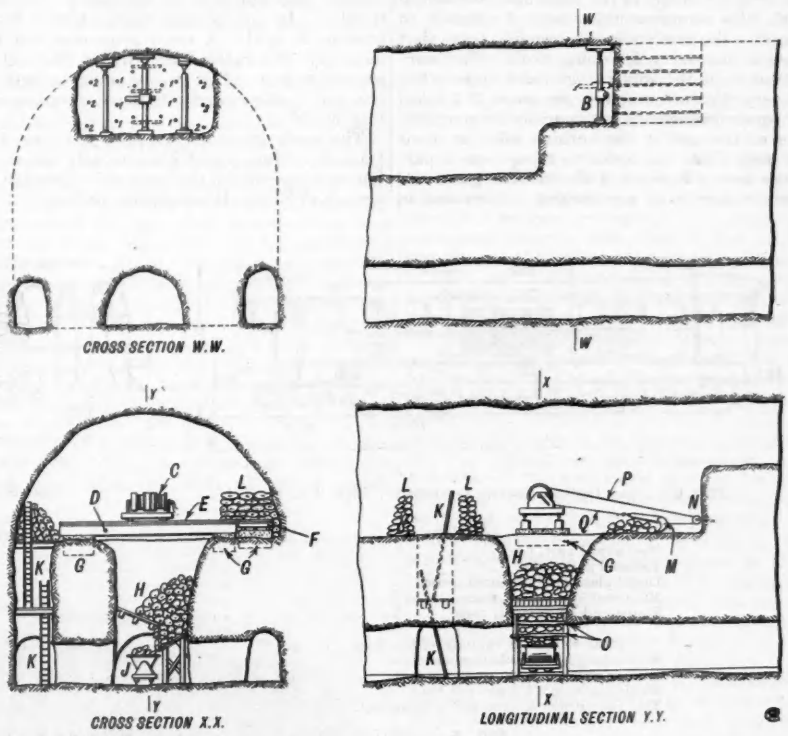
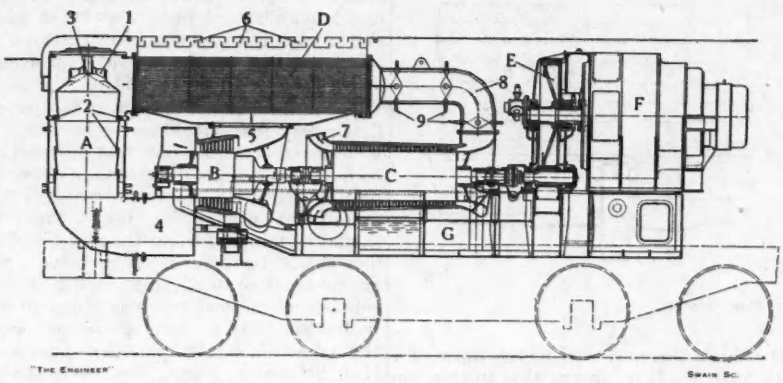


FIG. 3—EXCAVATION OF TUNNEL IN ROCK

The Gas Turbine Locomotive*

The Swiss Federal Railways ordered the first gas turbine locomotive in the world from us in 1939. The gas turbine set works to the so-termed constant-pressure principle (Fig. 1). The set consists of a combustion chamber in which the driving gas is produced by the combustion of oil which is mixed with cooling air, of a reaction turbine with several stages, which converts the energy of the gases into mechanical work, of a compressor the duty of which is to compress the combustion and cooling air to that pressure necessary for doing work. The compressor is of the multi-stage axial type. The delivery pressure amounts to about 3·5 kilos. per square centimetre gauge, while the temperature of the gas at the turbine inlet is about 550 deg. Cent. In order to recuperate a part of the heat contained in the exhaust gases and thus to save fuel, a preheater is provided in which the fresh air drawn in is heated by the exhaust gases being expelled.



A. Combustion chamber. C. Compressor. E. Reduction gear. G. Auxiliary frame.
B. Gas turbine. D. Air preheater. F. D.C. generator.

The compressed and preheated air is introduced into the combustion chamber partly as combustion air through the air nozzle ring (with vanes) 1, partly as cooling air through the slits 2, while the fuel is introduced through the injection nozzle 3. Combustion gas and cooling air mix in chamber 4, and form the driving gas proper. The exhaust gases, which are still hot, enter the preheater at 5 and leave it through the slits 6 in the locomotive roof. Air enters at 7. The air outlet duct 8 is provided with several expansion joints 9 on account of the different expansions of the gas-turbine set and the preheater.

Fig. 1—*Section of a Gas Turbine for a Locomotive*

The main generator supplies the four D.C. traction motors, which each actuate one of the four driving axles of the locomotive through the agency of Brown-Boveri spring drives.

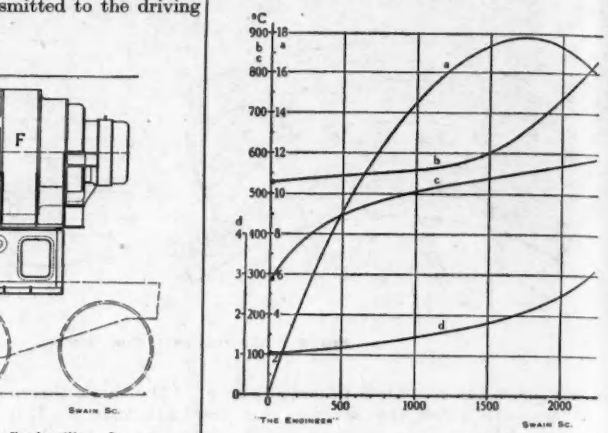
The heating generator delivers the power required to heat the trailers. When the temperature of the outside air drops, there is less work to be done by the air compressor and the useful output of the gas turbine increases; we therefore get more output in cold weather, which is quite sufficient to cover the heating requirements of the train. There being no water used, the locomotive is always ready for work, even in the coldest weather.

The third generator delivers D.C. for the auxiliary requirements, such as separate excitation of the main and of the heating generator, power for the compressor and pump motors, and to charge a storage battery.

There is a small converter set to supply the lighting of the locomotive and the control current circuit. This set reduces the voltage of the auxiliary generator or of the battery to 36 V, which is the standard lighting voltage of the Swiss Federal Railways. There is no separate lighting storage battery.

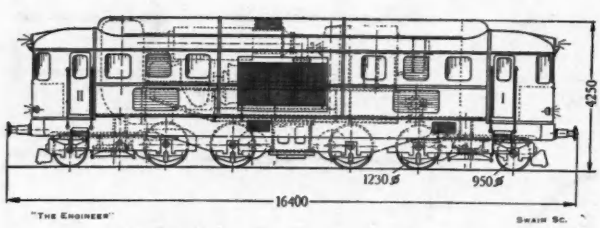
The starting of the main set is by electricity, the main generator being run as a motor and supplied with electric power from a diesel generator set. After attainment of the speed necessary for ignition, fuel is injected into the combustion chamber and ignited. The set then comes up to rated speed under its own power. With the diesel generator set, which can deliver a maximum of 110 H.P., the locomotive can run under no load without using the gas turbine at all.

The control system is similar to that of a diesel-electric locomotive, equipped with Brown-Boveri control. To operate the gas turbine it is necessary that it should run at a speed which is a function of the output it delivers. The controller in the cab is the main regulating organ at the disposal of the driver. It adjusts the fuel injection requisite to the momentary power requirement. Simultaneously, the closing position of a sleeve of a speed governor coupled to the gas turbine shaft is brought to the position corresponding to the speed of the set which is necessary for the compressor if it is to deliver that quantity of air requisite to the amount of fuel injected or desired output. If

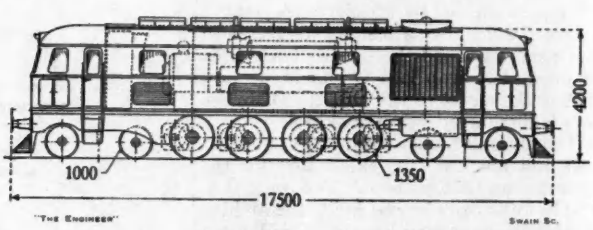


Abscissæ: Output in H.P.
Ordinates: *a*, Thermal efficiency in per cent.
b, Speed of generator in r.p.m.
c, Gas temperature at turbine inlet, deg. Cent.
d, Air pressure after compressor, kilos. per square centimetre abs.

Fig. 2—*Operating Characteristics of a Gas Turbine for Traction Purposes*



2200 H.P. Gas Turbine Electric Locomotive, Type 1 A_o-B_o-A_o 1



2200 H.P. Diesel-electric Locomotive, Type 2 D_o 2

Weight.	Locomotive 1 A_o-B_o-A_o 1 gas turbine locomotive.	Type 2 D_o 2 diesel-electric locomotive.
Mechanical part, tons	37·5	50
Thermal part, tons	23·7	—
Diesel plant and accessories, tons	—	26
Electrical equipment, tons	25·6	30·2
Stores and equipment, tons	5·2	5·8
Total weight in running order, tons	92	112
Maximum driving axle pressure, tons	16	16
Runner axle pressure, tons	14	12
Maximum speed, kiloms. per hour	110	100
The gas turbine locomotive is lighter by	20 tons	

Fig. 3—*Comparison Between a Gas Turbine Locomotive and a Diesel-electric Locomotive*

* From *The Brown Boveri Review*, August-September, 1941.

the momentary speed of the compressor deviates from this desired value, the speed governor varies the field of the generator through the agency of a Brown-Boveri servo field regulator, which then increases or lowers the power input to the generator until the gas turbine has reached the desired speed. The electric transmission permits of the speed of the gas turbine being independent of that of the motors.

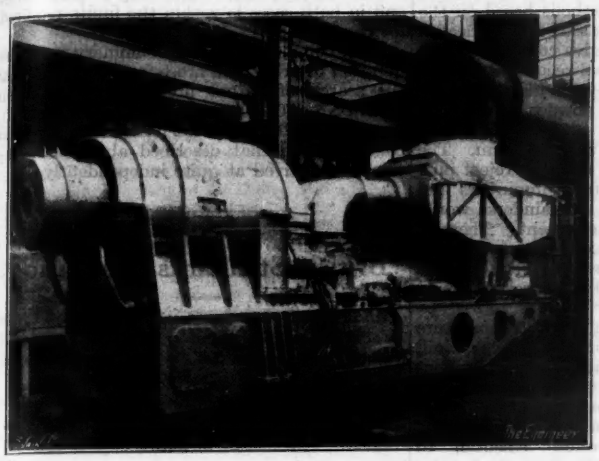


FIG. 4—*Generator Set of the Gas Turbine Locomotive on the Test Bed*

The momentary tractive effort of the locomotive (motor current) will always be adjusted by alteration of the generator excitation in such a way that it adapts itself to the speed (motor voltage) which corresponds to the output set on the turbine.

Performance of Gas Turbine Locomotive

Guaranteed continuous output of the thermal set, measured at generator coupling	2,200 H.P. at 5,200/812 r.p.m.
Power available for traction (less the power absorbed by auxiliary services)	2,000 H.P. at 4,800/750 r.p.m.
Tractive effort at wheel tread—	
During starting	13,000 kilos. from 0 to 26 kilom. per hour
During one hour	7,600 kilos. at 50 kilom. per hour
Continuous	4,840 kilos. at 78 kilom. per hour Maximum speed, 110 kilom. per hour.
Service weight with all stores	92 tons for service on secondary lines (lighter rails) 93·5 tons for service on main lines (standard rails)
Admissible driving axle load on secondary lines	16 tons
Admissible driving axle load on main lines	18 tons

The main data for the gas turbine electric locomotive for the Swiss Federal Railways are given in the table above.

The tractive effort speed data are for half-worn tyres of 1200 mm. rolling diameter, and assuming that the auxiliary and heating generators take 263 kW, corresponding to 42 kW delivered by the auxiliary generator and 200 kW by the heating generator. The fuel consumption is about 450 grams per horsepower-hour at the wheel tread. About 900 kilos. of oil are needed for 2000 H.P. delivered at the wheel tread per hour.

The whole thermal plant (Fig. 4) was mounted in our shops on a common auxiliary frame, which also contains the fuel and lubricating oil tanks. The whole set, with its auxiliary frame, was then installed in the locomotive and secured to the main frame.

Brown-Boveri gave the Swiss Locomotive and Machine Works, Winterthur, Switzerland, the order for the mechanical part. The locomotive was ready this summer; it is to be on trial with the Swiss Federal Railways for one year, and then taken over by them if it fulfils the conditions specified. It is to be used on those sections of the Swiss Federal Railway system which have not been electrified, or on main lines as a standby if current fails.

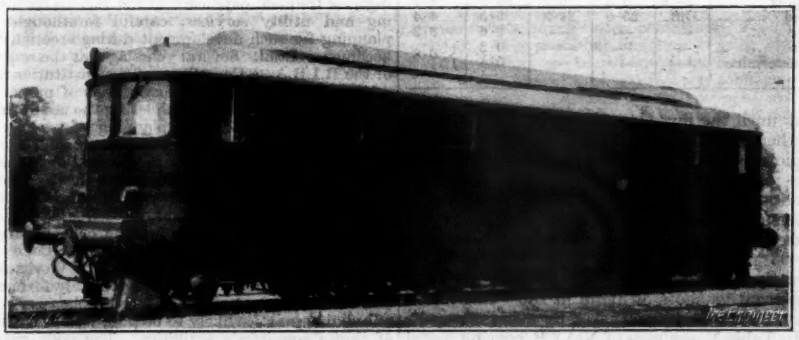


FIG. 5—*The Gas Turbine Locomotive of the Swiss Federal Railways, 2200 H.P., Type 1 A_o-B_o-A_o 1*

Railway Bearing Metals*

By J. N. BRADLEY,† A.R.S.M., B.Sc., and HUGH O'NEILL,† M.Met., D.Sc.

(*Continued from page 326, October 16th*)

Separation Conditions for the Bradley Process in Batch Operation.—White metals may be powdered throughout the solidus-liquidus range, but at the liquidus temperature itself no powdering takes place. Whilst a separation is possible by agitating anywhere in this range, the best results are obtained by working at an optimum temperature for each alloy and within a zone of 5 deg. Cent. Thus, for alloy 2 R, powdering commences at about 185 deg. Cent., but the best results are obtained at 200 deg. Cent. At this temperature the powder produced will pass a 40-mesh I.M.M. sieve, enabling any charge of mixed borings coarser than this to be treated. Operating at a lower temperature produces a small proportion of coarse white metal powder, while at a higher temperature some agglomeration appears to take place, resulting in the formation of some small balls varying in diameter from 0·02in. to 0·04in. Similar results have been observed with all white metals treated, and a narrow range for the operating temperature is considered best, that for alloy 1 R being at 220 deg. Cent.

* Institute of Metals, 1942.—Abstract.

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Use of "Contaminants."—This name has been given to materials inherently present in consignments of mixed borings, and also to materials intentionally added to charges as aids to separation. The former class includes wood shavings, dirt, pieces of broken crucibles, &c., which do not interfere, and oil, which does. Although no cutting lubricant is used in the machining of bearings in the L.M.S. shops, oil up to 0·4 per cent. is invariably present in mixed borings. It is partially vaporised at the separation temperature, but in batch working it tends to concentrate on the white metal powder produced and hinders its return to ingot form, whilst the effect on the actual separation itself is uncertain.

When dealing with rich batches (above 50 per cent. white metal) of alloy 2 R, it is desirable to add further contaminants in the proportion of 1 per cent. of the charge for every 25 per cent. white metal to ensure that no agglomeration of the white metal powder takes place. Many materials, such as plumbago or steatite, may be used for this purpose, though they introduce difficulties in connection with the return of the powder to ingot metal. It has therefore been found desirable to confine such additions to cheap and easily fusible materials, and the sodium carbonate-sodium chloride eutectic (56 per cent. sodium carbonate, 44 per cent. sodium chloride, m.p. 640 deg. Cent.) is suitable, for it later acts as a flux to free the white metal particles from their oxide coating.

Not all white metals require the addition of a contaminant to facilitate the separation; thus none is required for the high-tin alloy 1 R, but an addition is essential when powdering the lead-base alloy 3 R.

Continuous Operation of the Process.—To secure increased output the above plant was converted to continuous operation. For this purpose the furnace was fitted with a feed and preheater, as shown in Fig. 6.

The feed consists of a hopper and chute activated by a Sinex vibrator. Material discharges into a preheating furnace, designed in co-operation with the chief mechanical engineer's department, consisting of a gas-heated, thermostatically controlled, rotating drum, 5ft. long and 9in. in diameter. This is rotated at 20 r.p.m. by its own motor, and contains a charging helix for the first 6in., followed by two diametrically opposed fins, 2in. deep, extending along the remaining length. The drum communicates directly with that in the original furnace and the charge passes from one furnace to the other. Discharge of the treated material is effected by an extension cover with peripheral holes attached to the Birlec drum. This extension is enclosed by a metal chute which permits removal through the bottom of the furnace on to a container or a vibrating sieve. An agitation period of about ten minutes is required for disintegration of the white metal, and to permit the contents to remain in the furnace for this period the whole plant has an inclination of about 1 in 100. It was soon found that the forced air circulation system was unnecessary under these conditions, and it has been disconnected.

The continuous process is now giving very satisfactory results and the output is about 200 lb. to 300 lb. per hour. For mixtures containing alloy 2 R the preheater control is so arranged that the borings on passing to the second (separator) drum are heated to a temperature of 200 deg. to 220 deg. Cent. The temperature in the separator is maintained at 165 deg. Cent., *i.e.*, below the solidus of the alloy. Some powdering takes place in the preheater and the remainder takes place on a temperature gradient in the separator. As the exit temperature of the white metal powder is below the solidus, there is little or no tendency for the white metal powder to agglomerate, and the addition of contaminants has not been found necessary when dealing with the usual run of shop borings, containing up to 60 per cent. white metal. Mixed borings containing alloy No. 3 R have not been put through this plant.

The original separator furnace was efficiently lagged, but this has provided a difficulty with continuous operation, and eventually will necessitate alteration. The total heat carried through by the preheated borings exceeds that lost by the separator when the feed exceeds

180 lb. per hour. For short periods feeds of 300 lb. per hour can be successfully treated, and with a reduction in the insulation of the separator this output could be maintained. As the white metal content of the charge goes up the required period of agitation increases, and it is doubtful whether the plant will give a clean separation with charges containing over 70 per cent. white metal, unless the throughput is reduced. It may not be out of place to emphasise the toxic nature of the powder produced, so that efficient means are required to remove and collect the white metal values carried by the oil fumes issuing from the inlet end of the preheater, and generally to make the plant dust-tight.

Nature of Charges for the Bradley Process.—The dividing sieve may conveniently be of 30 or 40-mesh I.M.M. size, and charges of mixed borings coarser than this are suitable for treatment. Any finer bronze particles will be carried through with the white metal powder unless previously removed.

Charges of high white metal content should be considered for liquation treatment, followed by Bradley treatment of the sintered and contaminated bronze. This bronze liquation

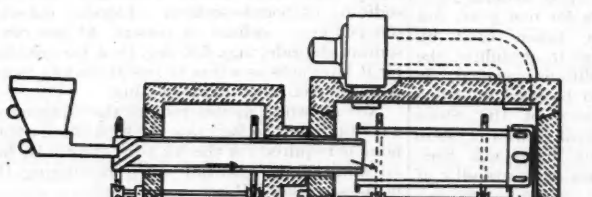

FIG. 6—*Furnace Adapted for Continuous Operation*

product is skimmed from the pots and passed down a vibrating metal chute, so arranged that at the bottom the white metal is solid. The material is then of suitable size for passing into the continuous feeder. Such a scheme works quite well, but both the bronze and white metal powder products require more renovation to restore them to specification analyses. Due to the limited output of the plant, it has been decided to use this dual method for charges high in white metal.

By batch operation it is quite feasible to obtain a fairly clean separation of any two fusible alloys with the required freezing range, provided that in the one with the lower solidus the optimum separation temperature does not exceed the solidus of the other. Actually more latitude may be allowed in special cases where the solidus is represented by only a small proportion of a low melting point eutectic. Alloy 1 R fulfils the above condition, and when treating mixed borings containing bronze and both 2 R and 1 R bearing metals, the 2 R alloy may be removed first, if desired, by operating at a temperature of 200 deg. Cent. and the 1 R alloy next separated from the bronze by a subsequent treatment at 220 deg. Cent.

Charges high in white metal (up to 100 per cent.) may be treated, though, as mentioned previously, the efficiency drops with such charges, owing to the production of some coarser powder. Thus, whilst bronze turnings aid disintegration of the bearing metal by their scouring action, they are not essential. Presumably powder is produced by breaking up along a liquid interface, and subsequent surface oxidation (aided by contaminants) prevents re-union. No appreciable segregation of the different white metal constituents occurs during powdering.

Treatment of the Separated Products.—The operating temperature is apparently too low to cause any tinning of the bronze bearings, and after the removal of the white metal powder by sieving, they may be melted and ingotted. Some slight adulteration is inevitable, and this is shown by a rise in the antimony and tin contents of the recovered bronze. The increase in the antimony content seldom exceeds 0·1 per cent. Recovered borings from the liquation process are tinned, and hence show a more marked difference in composition.

Analyses of bronzes obtained from treatment of alloy 2 R mixed borings and also from their liquated residues are given in Table V.

The reconversion of the whole of the white metal powder to ingot form is a matter of some difficulty when other than easily fusible contaminants are present. Methods based on the agitation of the powder in a sealed drum heated above the liquidus do not give complete reconversion, but the white metal recovered by this means is low in copper. By the indirect extrusion of clean white metal powder at 400 deg. Cent., about 90 per cent. of the white metal may be directly obtained in ingot form. The remainder is obtained as a compact reject plug containing all the non-metallic impurities and the oil residues. Such remainders would require a final smelting treatment. There is much to recommend the extrusion method, as the temperatures and pressures required are low, but its adoption has had to be postponed for the duration of the war.

The difficulty inherent in all low-temperature methods is due to the initial presence of oil, which is gradually concentrated as reconversion proceeds. For complete recovery it is therefore essential to work at temperatures at which the oil has been largely destroyed, and this in practice necessitates about 800 deg. Cent. being reached.

Due to oxidation, it is not practicable to melt even the clean white metal powder without the use of fluxes, and, of many tried, the salt-sodium carbonate eutectic mixture has proved the most economical and efficient in use. It is without significant attack on the white metal itself, and as it reacts exothermically with zinc and aluminium, effectively removes these metals if present in the white metal.

The powder, when mixed with 4 per cent. flux, can be directly melted to give bearing metal, and the operation may be carried out in a melting pot or small reverberatory type furnace. The most economical use of the flux is obtained by stirring the white metal powder into a bath of flux held in a melting pot. Successive small amounts can be added in this way until the flux cover becomes too pasty for further additions. During these operations copious oil fumes are given off, and even when the whole charge is molten, flames from oil residues are evolved. It is not practicable to wait until these have ceased and hence the "slag" is rather vesicular. By this means 97–98 per cent. of the white metal may be directly obtained in ingot form. The remainder is present as shots of metal in the "slag" and may, if desired, be recovered by other means.

In Table V analyses of No. 2 R bearing metal separated from shop consignments of clean mixed borings and liquated residues are given. In general, the increased copper content is the only appreciable change. It has been shown that it is practicable to effect a clean separation of each constituent and to reconvert the whole of the bronze and at least 97–98 per cent. of the white metal powder to ingot form.

TABLE V.—*Products of Bradley Process*

	Bearing metal (2 R).			Bronze.	
	Specification.	Ex clean mixed borings.	Ex liquated residues	Ex clean mixed borings.	Ex liquated residues
Tin...	58–60	60·0	60·2	8·1	12·4
Antimony ...	9–10	9·7	8·8	0·3	0·9
Copper	2– 6	5·3	6·7	84·9	78·2
Lead	Diff.	25·0	24·3	3·5	4·4
Zinc	—	—	—	2·6	3·3
Iron	—	—	—	0·2	0·8
Undetermined	—	—	—	0·4	

Charges in a fine state of division and also low in white metal have always been very difficult to treat by any process dependent on liquation, and for such material the method described is very well suited. The products obtained can be judged from the analyses quoted, and whilst the components cannot be recovered quite unaltered in composition, the total change is small, except in the case of liquated residues, and in both cases is within the limits required for economic renovation.

After completion of the preliminary work the question of protection arose, and it was during the search of patent literature that British Patent No. 270,740, by A. Schwarz (now lapsed), was found. This process has many points in common with that described above, but the two were arrived at quite independently.

British Standards Institution

All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria Street, London, S.W.1. The price of each specification is 2s. 3d. post free, unless otherwise stated.

WAR EMERGENCY CAMOUFLAGE COLOURS

No. 987 (C). The Institution has issued a range of eleven camouflage colours, which have been approved by the Ministry of Supply. The specimens measure 2in. by 3in. and have shade numbers by which they are to be known. Price 1s. 6d. (1s. 9d. post free).

INGOTS AND CASTINGS

Nos. 1058–1061—1942. These four specifications provide for two qualities of phosphor-bronze ingots and castings. They form part of a series of specifications for various non-ferrous castings which is being drawn up as a result of a request from the Directorate of Economy of the Ministry of Supply for economy in the tin used for cast-copper alloys. One of the qualities of phosphor-bronze—namely, that covered by B.S. 1058–9—corresponds to the phosphor-bronze covered by B.S. Aircraft Specification 2B8. The use of this quality is restricted to essential purposes, such as for aircraft work. The other quality (that covered by B.S. 1060–1) provides for a leaded phosphor-bronze with a tin content lower than that specified in B.S. 1058–9. Phosphor-bronzes in the past have been supplied for general engineering and maintenance work as sand castings or as chill-cast stick, using alloys of high tin content, such as that covered by B.S. 1058–9. In many cases such a high tin content is unnecessary, and, wherever possible, material conforming to B.S. 1060–1 should be used. It is recommended that as far as practicable scrap metal should be employed in the manufacture of leaded phosphor-bronze, leaving virgin metal for use in high tin content specifications.

ENGINEERING AND UTILITY SERVICES IN BUILDINGS

No. 1043. In view of the need, in modern buildings, for frequent expansion of the various engineering and utility services, careful forethought in planning for such development during erection has become essential. Several years ago, at the request of the R.I.B.A., a Committee of the Institution was set up to investigate the possibilities of preparing some standard guiding principles for the use of those concerned in the advance planning of services in buildings. Much scepticism was expressed, in the early stages of the work, as to the final outcome of the investigations, but the Committee has expended a great deal of time and patient effort on the problem, and the results of its deliberations are now embodied in B.S. 1043. The code has been submitted to the recently established Codes of Practice Committee of the Ministry of Works and Planning, and will in due course probably form one of a series of codes, or part of a comprehensive code of building practice likely to be produced as a result of that Committee's activities. The code covers such matters as the advance planning of the services, including a schedule of precedence of services, designs and methods of distribution of the services; proximity of services; fire risk; transmission of sound from services, and quotes some of the principal building by-laws controlling building construction which might have to be considered in relation to the installation of services. Price 2s. (2s. 3d. post free).

Markets, Notes and News

The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.t. Export quotations are f.o.b. steamer

Iron and Steel in the United States

The situation in the American iron and steel industry is satisfactory, although difficulties arise occasionally of the sort which are to be expected in wartime. Unfavourable weather on the Great Lakes, resulted in a falling-off in the iron ore shipments in September, which totalled 11,847,919 tons. To October 1st the total shipments for the season were 72,441,453 tons. Considerable construction work is being carried out on ore-shipping docks and pockets, to be used for the new direct Lake Michigan shipping route, which, it is anticipated, will be ready for the 1943 season. Five ore carriers for a subsidiary company of the United States Steel Corporation are now in commission. The blast-furnaces are producing pig iron to their full capacity, and the authorities are handling deliveries and applications efficiently. While there does not seem to be any real scarcity, consumers continually press for the installation of additional capacity to meet requirements in 1943. In the Youngstown district a new furnace of 1200 tons capacity, built by the Republic Steel Corporation, is going into operation, and will add 400,000 tons output to available pig iron capacity. The Youngstown Sheet and Tube Company have also put into blast a 1050-ton furnace to replace one of 750 tons, which was dismantled. Other furnaces are being built at various points, but their completion is somewhat delayed because of late deliveries of materials. They are expected to be in operation in the fourth quarter. It is expected that by the beginning of 1943 the additional new capacity will represent 2¼ million tons. Steel production has improved to an average of 98·67 per cent. of ingot capacity, representing about 1,686,700 tons weekly over the whole district. There has been a satisfactory response to the salvage drive to obtain scrap. Although a considerable proportion of the scrap obtained from households and small factories does not meet the strict specifications of the trade, the tonnage is heavy, and for ten States totalled 260,000 tons. In Brooklyn 43,000 tons were obtained in one day. The Government requisitioned from a Mid-Western local railway 18,000 tons, which included some usable rails.

The Pig Iron Market

The production of pig iron is maintained at a high rate, and is sufficient to meet the demand, which for some time past has been slowly gathering weight. The characteristics of the market change little. The hematite position is the most stringent, and in this department the Control is exercising great care in distribution. It seems to be generally agreed that although it would be desirable to increase the production of this description of pig iron, this is impracticable, since supplies of the necessary ores would have to be imported, and for the time being imports are restricted to other goods in more urgent request for the war effort. The production of home ores has been greatly increased, and the British production of hematite is probably at its peak. The necessity for conserving the supplies is creating a strong demand for substitutes, and low-phosphoric pig iron and refined irons are used in considerable quantities for this purpose. This has necessitated the Control keeping a watchful eye upon the distribution of these pig irons, and although the position is not difficult, there is a certain amount of stringency, both in refined and low-phosphoric grades. Owing to the careful supervision of applications for hematite and the maintenance of the home production, no great inconvenience has been caused consumers, but in many cases they have to use pig irons to which they are unaccustomed. The production of high-phosphoric pig iron would appear to be more than equal to the demand. This is chiefly due to the poor conditions which have prevailed since the war began in the light castings industry. Recently the light foundries appear to have been a shade more busy, and some of the jobbing foundries have been more actively employed. An increasing number of foundries find employment on engineering castings required in connection with armaments, munitions, and machine tools. This branch of the industry is likely to be busy for a long period. Foundries requiring high-phosphoric pig iron find no difficulty in obtaining their full requirements, and there is a tendency for the demand for high-phosphoric grades of pig iron to expand, as it is used in an increasing degree for purposes for which, in former days, it was not considered suitable.

The Midlands and South Wales

The Midland iron and steel works have a big tonnage of orders in hand, sufficient to keep them fully employed for the last quarter of the year. The most noticeable feature of the situation is the insistent request for steel plates, the largest demand coming from the shipyards, although substantial tonnages are taken up by the tank makers and wagon and locomotive builders. There is also no cessation in the continual inquiry for alloy steels, which are needed in ever-increasing quantities by the war industries. Efforts are continually being made to increase the production of these steels, and the output is now far greater than before the war, but, even so, the demand continues to tax the resources of the works. Active conditions rule in the structural steel department, and works are now fully employed in the production of joists and sections, and the call for medium sections is on a considerable scale. A short time ago the demands made upon the re-rollers showed signs of diminishing, but recently the business has increased, and works are now busy on producing light sections and small bars. The demand for reinforcing bars, also, which not long ago was rather quiet, has become more active, and there is a good request for strip. The position of the re-rolling industry is satisfactory, inasmuch as they are obtaining good supplies of semis. Home production is well maintained, and there are substantial stocks of imported material which can be drawn upon, if necessary. The steady expansion in the demand for iron and steel for war purposes is reflected in busy conditions at the works in South Wales. The call for plates shows no sign of decreasing, and includes ship, boiler, and tank plates, although it seems most urgent for ship plates. The tinplate industry is passing through a period of poor trade. This arises chiefly from the restrictions on the manufacture and use of tinplates which have been made necessary by wartime developments. Little export trade is possible, and the home trade demand is rather quiet. The demand for substitutes does not seem to make much progress. The sheet industry is well employed, and has sufficient orders in hand to keep it busy for several months, and business in black and painted sheets is growing.

Scotland and the North

The full capacity of the Scottish iron and steel trades is pressed to the utmost to meet the demands of the war industries. In some branches there is a tendency for delivery dates to lengthen, but efforts are made to check this whenever it becomes noticeable. Generally speaking, the works, although hardly pressed, are standing up to their task and consumers have little to complain about in the way of late deliveries. The volume of business in structural steel has expanded considerably in recent weeks, and now most of the firms producing this class of material are well provided with orders. The demand includes a fair request for light plates, as well as joists and sections. The heavy request for plates has become almost a permanent feature of the market, and has lasted now many months, and shows little sign of any decrease. Large tonnages are passing to the shipyards, and the boilermakers, locomotive and wagon builders, as well as the tank makers, are large consumers. The sheet trade is also in a satisfactory condition, although the volume of business in galvanised sheets, which are only made to special authorisation, is naturally limited. Large quantities of sheets, however, are being used in the construction of huts and for other structural purposes. The steel works are obtaining good supplies of raw materials, but the use of hematite is, of course, restricted. The re-rolling industry is in a satisfactory position, as there are ample stocks of billets, whilst there is a satisfactory tonnage of orders in hand. Lancashire constructional engineers are well employed, although many of them are doing a different class of work from that to which they are accustomed. This accounts to some extent for the moderate call for joists, but there has been an improvement in this respect recently. There is an active business passing in steel bars of all sizes. The engineering industry, which is almost entirely engaged upon war work, is taking considerable tonnages of the heavier sizes, whilst there is a sustained demand for small steel bars. Recently there have been some reports that supplies of acid quality billets are becoming more stringent. The rolling mills on the North-West Coast are fully employed, and the orders in hand should keep the works busy until after the turn of the year.

The North-East Coast and Yorkshire

It is an indication of the pressure under which the steel works are operating that the reserve stock of imported materials is still being drawn upon to supplement the home production. The latter is on a heavy scale, and the total production is considerable. The withdrawals from stocks are being carefully watched, and although the stocks in this country are considerable, it is not intended to allow these inroads seriously to deplete the accumulations that have been built up. The situation in most departments of the finishing trade is satisfactory since raw materials appear to be in good supply and outputs are maintained at a high rate. The call for steel plates is unabated, and the producing works are operating at considerable pressure to meet the insistent demand from the shipyards, tank makers, wagon builders, and heavy engineers. The shipbuilding industry has first claim on the production of plates, and other big consumers, including locomotive builders, are agitating for a larger share; but under present conditions it seems doubtful if this will be given them. There is an active demand for most descriptions of structural steel, and lately the requirements of the constructional engineers have considerably increased. The demand, however, appears to be principally for the light and medium sizes, although there is quite a good business passing in heavy joists and sections. The pressure to obtain supplies of alloy and special steels remains a feature of the market, and is met with difficulty by suppliers. In the Yorkshire steel market consumers continue to exert strong pressure upon the industry. Nearly all the production passes into consumption at the armament and munitions works. The demand for basic steel is extremely heavy, but, fortunately, there is no shortage of raw materials, and the producing works are able to fill all essential needs. The steady demand for special and alloy steels has been a feature of the market now for some time, but the requirements of the aircraft makers and armaments firms show no signs of relaxing. There is also an important business passing in tool steel, which covers almost every description. The scarcity of high-tungsten high-speed steel has been relieved in some measure by encouraging the use of substitutes, and this steel is now only issued in cases where substitutes are not suitable for the essential work for which it is required.

Iron and Steel Scrap

On the whole, steady conditions prevail in the iron and steel scrap market, and consumers, with a few exceptions, are obtaining all the scrap they require. In some districts transport congestion is reported, and this has interfered with business to some extent, but it is understood that a new system of regulating deliveries will be introduced shortly, and that this should rectify the position. Supplies of most descriptions of scrap are adequate to meet consumers' needs, but the demand is for the heavier sorts, and less interest is shown in the lighter descriptions. Good stocks are reported to be held at the steel works, but probably these would not be sufficient to last long if supplies were interrupted. There is a strong call for melting scrap, but, generally speaking, deliveries have been well maintained. The demand for heavy steel turnings varies in the different districts, and the quantities of the lighter blast-furnace quality is in excess of consumers' requirements. Mixed wrought iron and steel scrap is also in poor demand, but the basic steel furnaces are taking good quantities. Considerable activity rules in bundled steel scrap and hydraulically compressed steel shearings, but the works appear to be obtaining all the material they need. Recently the quantities of cast iron turnings coming on the market appeared to have declined, but, on the other hand, the steel works are not showing a great deal of interest in this description. There are good supplies of mixed wrought iron and steel scrap for basic steel making, and large quantities are available. The demand for nickel steel scrap is steady but it is not so strong as might be expected, considering the tight position of alloy steel. Some interest has been shown in nickel steel scrap, but buyers of nickel steel scrap containing other alloys are not displaying much activity. There is an active market for shovelable and crushed steel turnings. Practically all grades of cast iron scrap are eagerly taken up. A steady supply of short heavy steel scrap is noticeable, and best grade material is quickly taken up.

LOCOMOTIVE PRODUCTION IN U.S.A.—From reports made by locomotive builders to the U.S.A. Department of Commerce Bureau, the shipments for the first six months of 1942 totalled 699 locomotives, including 275 steam, 9 electrics, 388 diesel-electrics, and 27 of other types, as compared with 430 for January to June, 1941. Unfilled orders at the end of June were 1577 locomotives of all kinds, nearly double last year's comparable figures.

Notes and Memoranda

Rail and Road

South Africa Building Oil-engined Locomotives.—The Landsborough Findlay (S.A.) (Pty.), Ltd., has begun to construct oil-engined locomotives at its Denver works, Johannesburg, starting with heavy shunting engines for its own use and small 1½-ton locomotives suitable for the 50-cm. gauge line in the Belgian Congo.

Locomotives in the U.S.A.—The Association of American Railroads is concerned over the possibility of a shortage of motive power on the country's railways in the near future, and recently invited the Director of Defence Transportation to attend a meeting at which he promised that he would ask the War Production Board to increase the number of locomotives that may now be built under present W.P.B. allocations.

Germany Requisitions Repaired Rolling Stock.—It is reported from Belgium that nearly 32,000 wagons were repaired in 1941 and that 4800 were added to the National Railways' stock, which numbered about 98,500 by the end of the year indicated. Of that total, about 27,000 were in service on the Reichsbahn and other German-controlled railways. Three locomotives, 180 coaches, 6666 wagons, and various other vehicles were still listed as "missing" by the end of 1941, and all are now presumed lost through destruction.

Military Railway Construction.—The driving of a golden spike in the Claiborne and Polk Military Railway, a 50-mile single-track line connecting camps Claiborne and Polk in Louisiana, marked the completion of the first Army-built, strictly military railway in the history of the U.S.A. Moreover, the work demonstrated what the Military Railway Service can do in theatres of military operation if called upon—and laid the groundwork for the training of thousands of officers and men in railway operation and maintenance under wartime conditions. A feature in the undertaking was the bridgework, because the majority of the troops employed had had little or no prior experience in bridge construction or any form of heavy timber work. Altogether, there are twenty-five bridges on the line.

Railway Salvage.—The Ministry of Works and Planning has arranged with the Ministry of War Transport and the Great Western Railway to take for scrap the Weston, Clevedon, and Portishead light railway, and demolition of the line has already begun. Everything on this 14½-mile railway, with its seventeen intermediate stations and fourteen level crossings, will be recovered to play some important part in the war effort—rails, sleepers, fish-plates, dogs, underbridges, signal apparatus, point-switching gear, water tanks, and even the seventeen small "shed" stations with their sheltered waiting-rooms. It is estimated that over 1600 tons of metal will be collected. In addition, 15,000 sleepers will be available for use as foundations for aerodrome runways and cart roads or factory sidings.

Air and Water

Washington Wants Water.—War conditions are putting a heavy strain on the water supply system of America's capital city. To meet the demand, water is being stored behind the incomplete Brighton dam of the Washington Suburban Sanitary Commission. The dam, on the Patuxent River, near Laurel, Md., will store 6·5 billion gallons of water to serve the several communities outside Washington that have combined into a sanitary district.

A Canadian Dam Completed.—The Shand dam, the main control structure of the Grand River Conservation Commission in South-Western Ontario, has been officially dedicated by Premier Hepburn, of Ontario. It is situated near Fergus, on the upstream section of the Grand River, and was begun in 1939, and practically completed in 1940. The final construction work, however, was held up during negotiations for relocating a railway over the crest of the dam. The estimated total cost was 2,000,000 dollars, and the project was actually completed at a cost of 1,900,000 dollars.

Ropeways in Europe.—The construction of what may well be the longest ropeway in Europe has been begun by the port authorities at Genoa, although it is being built for and will be operated by the Italian State Railways. It is to connect the port of Genoa with Arquata Scrivia, a distance by rail of 27 miles; the length of the ropeway, however, will be 21 miles. The difference in level between the port and Arquata Scrivia is nearly 800ft., but at one point the rope will have to rise to nearly 1200ft. This aerial track will carry only goods traffic. Meantime, France has completed the world's highest ropeway, connecting Chamonix, in the French Alps, south of the Lake of Geneva, with the top of the Aiguille du Midi. Its length is about 12,000ft. A large telescope lens was in the first consignment carried to the top of the mountain, where a meteorological observatory has been erected.

Miscellanea

The Late Mr. Keith Benham.—We regret to learn of the death of Mr. Keith Benham, managing director of the Universal Grinding Wheel Company, Ltd., Stafford. He died at his home, Burton House, Stafford, on October 12th.

Carborundum from Canada.—The Canadian Carborundum Company, Ltd., is to extend, at a cost of 700,000 dollars, its plant at Niagara Falls, Ont. The additions will include new furnace building and several transformer buildings.

A Mobile Laboratory.—In order to safeguard the health of its thousands of employees on construction and other works, the Tennessee Valley Authority has recently put into service a travelling X-ray laboratory. The Authority periodically makes lung examinations of hundreds of employees and the mobile laboratory will greatly widen the scope of this service. When not travelling, jacks suspended below the chassis are let down and the vehicle is hoisted on them, so that the unit is steady and level while X-ray work is in progress.

Heavy Scrap Metal.—Information regarding the location of heavy scrap metal is urgently wanted by the Ministry of Works and Planning. It is believed there are still premises containing more than 3 tons of metal suitable for scrap which has not been notified under the Order, which required returns to be made by October 21st. The following are some typical examples of the kinds of metal notified to the Ministry: 100 tons of sheet metal ready for shifting from a Blackpool engineer's workshop; 60 tons of wheels, gears, pylons and a locomotive engine from a Yorkshire chemical works; 50 tons of mixed steel and cast iron from Birmingham; and 20 tons of machinery from a Lancashire cotton mill. Under the Regulations (56 AAA), the occupiers of all premises in England, Scotland, and Wales on which there were on September 21st 3 or more tons of metal suitable for scrap had to make a return to Scrap Recovery, Ministry of Works, Sanctuary Buildings, London, S.W.1. Forms on which the return should be made can be obtained from that address and should have been returned by October 21st. Everything that is obsolete, redundant, or serving no immediate purpose, and that contains any metal, except magnesium or aluminium or their alloys, should be included in this return. It is the occupier of the premises who has to make the return, whether or not he owns the metal. In the case of empty premises it is the person who is entitled to occupy them who has to make the return.

Personal and Business

Mr. Alan Greig has been appointed secretary of the Blyth Dry Dock and Shipbuilding Company, Ltd.

Mr. F. W. Godden has been appointed engineer and manager of the Coventry City electricity undertaking.

Mr. Arnold Throp, works manager of Edward Pryor and Son, Ltd., has been appointed a director of the company.

Mr. G. Bryden has been elected a director of Marshall, Sons and Co. (Successors), Ltd., and has been appointed general manager.

John Holroyd and Co., Ltd., inform us that their London office, under the control of Mr. Vincent Gartside, is now at 10, Princes Street, Westminster, S.W.1.

The Minister of Aircraft Production has invited the following gentlemen to serve in an honorary capacity as technical advisers to the Light Metals Control (Castings) in association with representatives of the Light Metal Founders' Association:—Mr. A. S. Beech, M.I. Mech. E., chairman and managing director of Foundry Equipment, Ltd., and High Grade Castings, Ltd.; Mr. G. E. France, managing director of August, Ltd., and a director of the Rendon Manufacturing Company (Great Britain) and Supplies Association, Ltd.; and Mr. J. Vickers, foundry manager of Rolls-Royce, Ltd., Glasgow.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Fuel Luncheon Club

Wednesday, Oct. 28th.—Connaught Rooms, Great Queen Street, Kingsway, W.C.2. Presidential Address, Sir David Milne-Watson. 12.40 for 1.10 p.m.

Institution of Civil Engineers

Saturday, Oct. 24th.—N.W. Assoc.: Engineers' Club, Albert Square, Manchester. Chairman's Address, "Some Ancient Waterworks," E. C. Oakes. 2.30 p.m.

Institution of Electrical Engineers

To-day, Oct. 23rd.—Measurements Section: Savoy Place, Victoria Embankment, W.C.2. Chairman's Address, E. H. Miller. 5.30 p.m.—N.W. Students: Neville Hall, Westgate Road, Newcastle-upon-Tyne. "Installation and Maintenance of Large Power Transformers," H. D. Briggs. 6.30 p.m.

Saturday, Oct. 24th.—S. Midland Centre: Grand Hotel, Birmingham. Chairman's Address, R. H. Rawll. 1 p.m.

Monday, Oct. 26th.—Savoy Place, Victoria Embankment, W.C.2. Discussion, "Space and Domestic Hot Water Heating for Post-war Buildings," Professor C. L. Fortescue. 5.30 p.m.—N.E. Centre: Neville Hall, Westgate Road, Newcastle-upon-Tyne. "Fluorescent Lamps," L. J. Davies, H. R. Ruff, and W. J. Scott. 6.15 p.m.

Saturday, Oct. 31st.—N. Midland Students: Visit to David Brown and Sons, Ltd. 2.45 p.m.

Monday, Nov. 2nd.—S. Midland Centre: James Watt Memorial Institute, Birmingham. "Coal for Steam Raising," J. N. Waite. 6 p.m.

Wednesday, Nov. 4th.—Wireless Section: Savoy Place, Victoria Embankment, W.C.2. "A Study of Propagation Over the Ultra-short-wave Radio Link Between Guernsey and England on Wavelengths of 5 m. and 8 m. (37·5 mc/s. and 60 mc/s.)," Miss A. C. Strickland and R. L. Smith-Rose. 5.30 p.m.

Thursday, Nov. 5th.—Savoy Place, Victoria Embankment, W.C.2. Joint meeting. "Coal for Steam Raising," J. N. Waite. 5.30 p.m.

Institution of Mechanical Engineers

To-day, Oct. 23rd.—Storey's Gate, Westminster, S.W.1. Presidential Address, "Boilers—Past and Present," Colonel S. J. Thompson. 5.30 p.m.

Saturday, October 24th.—London Graduates: Storey's Gate, Westminster, S.W.1. "Steam Generation and Distribution in a Large Factory under Wartime Conditions," G. M. Smith. 3.30 p.m.—N.W. Graduates: Engineers' Club, Albert Square, Manchester. "Calculations of Simple Combustion Processes," Professor G. E. Scholes. 2.30 p.m.

Monday, Nov. 2nd.—N.E. Section: Neville Hall, Newcastle-upon-Tyne. "Boilers: Past and Present," Colonel S. J. Thompson. 6 p.m.

Friday, Nov. 6th.—Storey's Gate, Westminster, S.W.1. Thomas Hawksley Lecture. "Recent Developments in Refrigeration," Lord Dudley G. Gordon. 5.30 p.m.

Saturday, Nov. 7th.—N.W. Branch: Engineers' Club, Albert Square, Manchester. "Welding," R. W. Bailey and J. A. Dorratt. 2.30 p.m.—Western Branch: Merchant Venturers' Technical College, Unity Street, Bristol. "Recent Developments in Refrigeration," Lord Dudley G. Gordon. 2.30 p.m.

Institution of Production Engineers

To-day, Oct. 23rd.—Institution of Civil Engineers, Great George Street, S.W.1. Twenty-first birthday celebration meeting. 3 p.m.

Friday, Oct. 30th.—Manchester Section: Mechanics' Institute, Crewe. "Surface Finish," Dr. G. Schlesinger. 7.15 p.m.

Saturday, Oct. 31st.—Manchester Section: The University, Brownlow Hill, Liverpool. "Surface Finish," Dr. G. Schlesinger. 2.30 p.m.

Wednesday, Nov. 4th.—Sheffield Section: Royal Victoria Hotel, Sheffield. "Surface Hardening," A. E. Shorter. 6.30 p.m.

Junior Institution of Engineers

To-day, Oct. 23rd.—39, Victoria Street, S.W.1. "Production in Small Factories," V. L. Ruddy. 6 p.m.

Keighley Association of Engineers

To-day, Oct. 23rd.—Victoria Hotel, Keighley. "Life in Bolton Priory Six Centuries Ago," C. Whone. 7.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders

Friday, Oct. 30th.—Mining Institute, Newcastle-upon-Tyne. "Some Considerations in the Design of High-speed Cargo Vessels," G. S. Baker. 6 p.m.

North of England Institute of Mining and Mechanical Engineers

Saturday, Oct. 24th.—Neville Hall, Newcastle-upon-Tyne. General meeting. 2 p.m.

Society of Chemical Industry

Wednesday, Nov. 4th.—Road and Building Materials Group: Gas Industry House, 1, Grosvenor Place, S.W.1. "The *Rôle* of Moisture in Soil Mechanics," R. K. Schofield. 4 p.m.